DEPARTMENT OF AGRICULTURE.

CHEMICAL DIVISION.

BULLETIN No. I.

AN INVESTIGATION

OF

THE COMPOSITION

OF

AMERICAN WHEAT AND CORN.

CLIFFORD RICHARDSON,

ASSISTANT CHEMIST.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

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VARIATIONS IN THE COMPOSITION OF WHEAT AND CORN AS INFLUENCED BY ENVIRONMENT.

The investigation of the wheats and corn of our country, which has been carried on in the laboratory of the Department under my direction for the past two years, is so far completed that the following report upon the results obtained will be of interest.

THE COMPOSITION OF AMERICAN WHEAT.

The wheat grain will be considered first, having absorbed much the largest amount of attention. The specimens which were analyzed are described as follows:

Wheat distributed by the Department in 1878.

Winter Varieties:

1. *Mold's Winter.* Grown in England.
2. *Mold's Red.* Grown in England.
3. *Yellow Missouri.* Grown in Missouri.
4. *Swamp.* Grown in Ohio.
5. *Victor.* Grown in Ontario, Canada.
6. *Silver Chaff.* Grown in Ontario, Canada.
7. *Foizy.* Grown in Oregon.
8. *Brazilian.* Grown in Oregon.
9. *Polish.* Grown in Maryland.
10. *White.* Grown in Oregon.

Spring Wheats:

11. *Improved Life.* Grown in Ontario, Canada.
12. *Champlain.* Grown in New York.
13. *Defiance.* Grown in New York.
14. *Chili Club.* Grown in Oregon.
15. *Noah Island.* Grown in Oregon.

Wheats grown in Colorado by Prof. A. E. Blount in 1881.

719. *Blount's Hybrid, No.* 10. A cross of the New York Diehl on Virginia Golden Straw.

720. *Blount's Hybrid, No.* 15. A cross of the Sonora on the Lost Nation.

721. *Blount's Hybrid, No.* 16. A cross of the Improved Fife on the Russian.

722. *Blount's Hybrid, No.* 16. A cross of the Odessa on the Sonora.

723. *Blount's Hybrid, No* 17. A cross of the Australian Club on the Improved Fife.

724. *Blount's Hybrid, No.* 19. A cross of the Improved Fife on the Oregon Club.

725. *Blount's Hybrid, No.* 20. A cross of the Oregon Club on the Sonora.

726. Seed from New South Wales.

727. *Black Bearded Centennial.* "From seed originally from New South Wales. Probably the heaviest wheat known, 74 pounds per struck bushel. It is an enormous feeder and an enormous yielder, 2 ounces producing, in 1880, 25 pounds 6 ounces."

728. *Eldorado.* "An improvement on the old Egyptian wheat, otherwise called Pharaoh's wheat, Seven-Bearded wheat, Mummy wheat, &c. In Larimer County, Colorado, it produces 90 bushels per acre."

729. *White Mexican or White Siberian.* "It originally came from Siberia. It has held its own more tenaciously than any of the standards. It is liable to rust on damp soils and has a weak straw. It has improved on Colorado soil in ten years of growth."

730. *Judkin.* "A Pennsylvania wheat, and one of the best winter varieties." Professor Blount turned it into a spring wheat in 1878, and it has since proved to be one of the best.

731. *Australian Club.* "One of the most prolific and successful varieties for the farmer. It produced 416 from 1 in 1880. The straw, color, and grain can hardly be excelled. It is no kin to the hard and soft Australian wheats. It is hard and has a large amber kernel."

732. *White Fountain.* "From Montana, and grown in Colorado but one year. It yields 404 from 1, has a stiff, strong, straw, does not rust, and ripens early. It gave 101 pounds from 4 ounces, of smooth, white wheat of great value."

733. *Perfection.* "From Palestine, in 1880, under a variety of names. A half ounce gave 6 pounds of grain and 7 of straw, the latter coarse, strong, and stiff; the grain large, white, and uniform in color."

734. *Russian.* "From Moscow in 1880. One of the best red wheats. Its failing is, shelling too easily when cut too ripe. The first year it produced 76 from 1, the second, 172 from 1, the third year, 448 from 1."

735. *Rio Grande.* "It shells badly."

736. *Touselle.* "From France. It is the finest looking of all the bearded French wheats. It improves rapidly by selection and cultivation."

737. *German Fife.* "From Saxony. Grown in Colorado but one year. One of the best wheats grown anywhere; a bearded red variety. One ounce produced 7 pounds of grain and 8 of straw, 112-fold."

738. *Oregon Club.* "This variety has deteriorated by bad selection.

It is prolific, nevertheless, producing, in 1881, 480 from 1. The seed from Oregon."

739. *Sonora.* "Produced the first year 56 from 1, 110 from 1 the second year, and 448 from 1 the third year. It came from Mexico below the Gulf of California."

740. *Improved Fife.* "It has exhibited no failing in three years, producing, first, 56 from 1, second, 126 from 1, and the third year, 416 from 1."

741. *Lost Nation.* "Seed from Chester County, Pennsylvania, three years before. It produced 352 from 1 in the third year, having given 96 pounds in the second, and 76 from 1 in the first year."

742. *Pringle's Hybrid, No.* 4.

743. *Pringle's Hybrid, No.* 6. "These varieties are from Vermont, and are not profitable, as they shell badly."

747. *Clawson.* "This winter variety refuses almost entirely to be transformed into a spring wheat. In Colorado it has produced the first year 68, the second 136, and the third year 544 from 1."

745. *Hedge Row White Chaff.* "From an unknown source. Too chaffy."

746. *Hedge Row Red Chaff.* "Like the preceding."

747. *White Chaff.* "A bearded variety yielding 400 from 1."

748. *Tritieum.* "From Samara, on the Volga River."

749. *Durum.*

750. *Doty.* "These wheats came from Saratov, Russia, in 1880."

751. *Mcekins.* "From St. Petersburg."

Seed distributed by the Department in 1882.

752. *Russian Spring Red.* Imported.

753. *French Imperial Spring.* Imported.

From Michigan Agricultural College, Lansing, Mich.

754. *Shumaker.* Crop of 1881. Raised four years consecutively on the college farm. Yield, 15 bushels per acre.

755. *Clawson.* Crop of 1881. Sixth year on college farm. Yield, 20 bushels. The soil at the college farm is a sandy loam, and the season considered a poor one for wheat in that locality.

From Missouri Agricultural College, Columbia, Mo.

756. *Fultz.* Crop of 1879. "Grown in Missouri more than any other."

757. *Shumaker.* Crop of 1879. "Much esteemed."

758. *Zimmerman.* Crop of 1879. "Much esteemed."

759. *Clawson.* Crop of 1879. "Yields best of any sure wheat, but not liked by millers."

760. *Russian, No.* 2. Crop of 1879. "Is a new wheat with us, but promises well."

761. *Smooth Mediterranean.* Crop of 1879. "Highly esteemed."

762. *Silver Chaff.* Crop of 1879. "Most productive. Apt to rust."

In addition to the above comments, Dr. Swallow says that he has sent these varieties as typical of those doing best in Missouri, and has selected the 1879 crop as being above the average.

From F. H. Hosford, Charlotte, Vt.

763. *A crossed wheat.* Labeled $\frac{D}{C}$ '78.

From D. Steck, Pennsylvania.

764. *Hybrid Winter.* Originated by Daniel Steck, Hughesville, Lycoming County, Pennsylvania.

From J. F. Jones, Georgia.

765. *Purple Straw.* Hogansville, Ga.

From J. O. McGehee, Virginia.

766. *Hybrid Winter.* Originated by J. O. McGehee, Bellefont, Nottoway County, Va.

From D. O. Landreth & Son, Philadelphia.

767. *Landreth.* Originated by H. S. Bonnell, Seneca County, New York.

From James Twamley, Dakota.

768. *Castle Fife.* Seed imported and raised by James Twamley. Grand Forks, Dak.

From J. F. Jones, Georgia.

769. *Italian White.* Hogansville, Ga.

770. *Spring wheat.* Hogansville, Ga.

From G. Belshaw, Oregon.

772. *Hudson Bay Winter.* Crop of 1881. George Belshaw, Eugene City, Lane County, Oregon.

773. *Violet Chaff Winter.*

774. *Red Chaff Spring.*

Seed distributed by the Department in 1882.

775. *Tennessee Amber.* Grown by J. W. Sparks, Murfreesborough, Tenn. Crop of 1881.

776. *Osterey Winter.* Imported from Osterey, Russia, in 1876, and

since then has been grown upon the college farm at Columbia. It is a beardless white wheat. Crop of 1882. Sixty-five pounds per bushel. It is said by millers to have good milling qualities.

778. *Swamp.* Grown by J.W. Sparks, Murfreesborough, Tenn. It is the product of Ohio Swamp, grown for several years in Tennessee.

779. *White Mediterranean.* Imported. Weighs sixty-five pounds to the bushel.

From Pickering Dodge, Virginia.

780. *Red Winter.* Grown at Shenandoah Alum Springs, Va., on new ground; no fertilizers. Sown broadcast after moistening and rolling in plaster. Yield, 7 bushels per acre. Crop of 1882.

781. *Red Winter.* The same wheat as 780, grown after corn. Drilled in with lime and manure. Crop of 1882.

Red Winter. Grown at Mount Jackson, Va., on limestone land. Crop of 1882.

From Judge J. M. Robinson, Maryland.

783. *Fultz.* Crop of 1882 used as seed for 1883. The crops for 1883 were collected later, and are numbered 1821 and 1822.

Seed distributed by the Department in 1882.

784. *Red Mediterranean.* Imported seed.

Seed distributed by the Department in 1881, *and crops grown by Professor Blount, Fort Collins, Colorado, in* 1882.

785. *McGehee's Red.* Crop of 1881. Originated by J. McGehee, Bellefontaine, Va.

786. *Crop from* 785. By Professor Blount, of Colorado.

787. *Finlay.* Department distribution.

788. *Finlay.* Professor Blount's crop from 787.

789. *Champion Amber.* A hybrid variety, originated by J. M. Hughes, York, Pa. Crop of 1881.

790. *Champion Amber.* Crop of Professor Blount, from 789 in 1882.

791. *Bill Dallas.* A wheat originated in Georgia. Crop of 1881.

792. *Bill Dallas.* Professor Blount's crop, 1882, from 790.

793. *Bennett.* Department distribution, 1881.

794. *Bennett.* Professor Blount's crop, 1882.

795. *Lemon.* A hybrid of the Champion Amber and Hughes' Prolific, yielding 35 bushels to the acre. Originated by J. M. Hughes, York, Pa. Crop of 1881.

796. *Lemon.* Professor Blount's crop of 1882, from 795.

797. *Gold Medal.* Department distribution of crop of 1881.

798. *Gold Medal.* Professor Blount's crop of 1882 from seed of 1881 distributed by the Department.

799. *German Amber.* Department seed of 1881.

800. *German Amber.* Professor Blount's crop in Colorado in 1882.

801. *Riee.* A variety grown by Milton R. Rice, Frederick, Md.

802. *Riee.* Crop grown by Professor Blount in 1882 from seed of Milton Rice.

803. *Washington Glass.* Seed distributed in 1881 by the Department.

804. *Washington Glass.* Crop of 1882, raised by Professor Blount in Colorado.

805. *Swamp.* The variety described under 778. Another lot distributed by the Department in 1881.

806. *Swamp.* Crop of 1882, grown by Professor Blount from seed distributed by the Department in 1881.

807. *Wysor.* A variety raised by Hugh C. Wysor, Newbern, Pulaski County, Virginia. Crop of 1881, distributed by the Department.

808. *Wysor.* Crop raised by Professor Blount in Colorado, in 1882, from previous seed.

Seed distributed by the Department in 1882.

809. *Riee.* Another portion of that described as 801.

Seed from J. R. Baker, Johnstown, Dak.

810. *Scotch Fife.* Yield, 27½ bushels per acre.

From North Carolina State Fair, 1882.

811. *Kivet.* Grown by J. Reich, Winston, N. C.

812. *Kivet.* Grown by Glenn & Franklin, Winston, N. C.

813. *Rust Proof.* Grown by S. A. Osborn, Winston, N. C.

814. *Rust Proof.* Grown by George Mitchell, Winston, N. C.

815. *Earnhardt.* Grown by J. P. Crews, Winston, N. C.

816. *Golden Premium.* Grown by D. Endsley, Winston, N. C.

817. *Winter Green.* Grown by George Mitchell, Winston, N. C.

818. *Baltimore.* Grown by M. M. Stewart, Salem, N. C.

819. *Baltimore.* Grown by Wm. Myers, Salem, N. C.

820. *White.* Grown by J. E. Mickey, Salem, N. C.

821. *White.* Grown by Albert Ebert, Salem, N. C.

822. *Davis.* Grown by J. L. Pratt, Mount Tabor, N. C.

823. *Davis.* Grown by J. A. Petree, Mount Tabor, N. C.

824. *Purple Straw.* Grown by J. A. Petree, Mount Tabor, N. C.

825. *Purple Straw.* Grown by J. J. Marshall, Lewisville, N. C.

826. *Rust Proof.* Grown by A. E. Conrad, Lewisville, N. C.

827. *Hieks Prolific.* Grown by A. E. Conrad, Lewisville, N. C.

828. *Baltimore.* Grown by R. L. Cox, Ledge Garden, N. C.

829. *Kivet.* Grown by R. L. Cox, Ledge Garden, N. C.

830. *Davis.* Grown by E. N. Spear, Bethania, N. C.

831. *Kivet.* Grown by Jacob Glenn (colored), Winston, N. C.

From Pusey & Shelmire, Avondale, Pa.

832. *Mountain White.* "Forty-four bushels per acre." Crop of 1882.
833. *Mediterranean.* "Sixty-one pounds per bushel."
834. *Fultz.* "Sixty-two pounds per bushel."
835. *Swamp.* "Sixty-four pounds per bushel."

From Louis Flook, Dallas Co., Texas.

1610. *Nicaraguan Wheat.* Yield, 40 bushels per acre. Valued at only 75 cents per bushel on account of its poor milling qualities, being flinty hard.

From V. M. Metcalf, Hopkinsville, Ky.

1280. *Fultz.* Crop of 1879.

From Eastern Experimental Farm, West Grove, Chester County, Pennsylvania.

1281. *Swamp.* Crop of 1879.
1282. *Hedge's Prolific.* Crop of 1879.
1283. *Glick.* Crop of 1879.
1284. *Champion Amber.* Crop of 1879.
1285. *Mediterranean White Chaff.* Crop of 1879.
1286. *Sandimika.* Crop of 1879.
1287. *Fultz.* Crop of 1879.
1288. *Gold Dust.* Crop of 1879.
1289. *Eureka.* Crop of 1879.
1290. *Washington White.* Crop of 1879.
1291. *Clawson.* Crop of 1879.
1292. *Gold Medal.* Crop of 1879.

From Michigan Agricultural College, Lansing, Mich.

1293. *Silver Chaff.* Crop of 1879.
1294. *Louisiana White.* Crop of 1879.
1295. *Jersey Red.* Crop of 1879.
1296. *Power's White.* Crop of 1879.
1297. *Dot.* Crop of 1879.
1298. *Michigan Wick.* Crop of 1879.
1299. *Schaeffer.* Crop of 1879.
1340. *Lancaster Red.* Crop of 1879.
1341. *Velvet Chaff.* Crop of 1879.
1342. *Shumaker.* Crop of 1879.
1343. *Armstrong.* Crop of 1879.
1344. *Muskingum.* Crop of 1879.
1345. *Mediterranean.* Crop of 1879.
1346. *Red Russian.* Crop of 1879.
1347. *Diehl.* Crop of 1879.

1348. *Clawson.* Crop of 1879.
1349. *Jennings' White Winter.* Crop of 1879.
1350. *Buckeye.* Crop of 1879.
1351. *Trump.* Crop of 1879.

Seed distributed by the Department in 1879.

1352. *Fultz.* Grown in Pennsylvania in 1879.
1353. *Centennial Black Bearded* or *New South Wales.* Grown in Baltimore County, Md. Crop of 1879.
1354. *Clawson.* Grown in Greene County, Pennsylvania. Crop of 1879.
1355. *Midge Proof.* Grown in Prince George County, Maryland. Crop of 1879.
1356. *White Australian.* Grown in North Carolina. Crop of 1879.
1358. *Silver Chaff.* Grown in Province of Ontario. Crop of 1879.
1359. *Midge Proof.* Grown in Province of Ontario. Crop of 1879.
1360. *Arnold Victor.* Grown in Province of Ontario. Crop of 1879.
1361. *Harrison.* Grown in Cumberland County, Virginia. Crop of 1879.

From the exhibit of the Saint Paul, Minneapolis and Manitoba Railroad, at the Department of Agriculture.

1900. *Egyptian.* Probably crop of 1881.
1901. *Scotch Fife.* Probably crop 1881.
1902. *Red Fern.* Probably crop of 1881.
1903. *Fife.* Probably crop of 1881.
1904. *Old Letters.* Probably crop of 1881.
1905. *Red Fern.* Probably crop of 1881.
1906. *Fife.* Probably crop of 1881.
1907. *Golden Drop.* Probably crop of 1881.
1908. *White Fife.* Probably crop of 1881.

From the exhibit of the Louisville and Nashville Railroad, at the Department of Agriculture.

1909. *Amber.* Grown in Henry County, Tennessee.
1910. *Fultz.* Grown in Henderson County, Kentucky.
1911. *Red.* Grown by J. W. Harris, Henry County, Tennessee.
1912. *Bearded.* Grown in Carroll County, Tennessee.
1913. *Odessa.* Grown by C. J. Kaufman, Russellville, Ky.
1914. *Fultz.* Grown by W. C. Warfield, Montgomery County, Tennessee.
1915. *Fultz.* Grown by J. B. Killebrew, Montgomery County, Tennessee.
1916. *German Amber.* Grown in Hopkinsville, Ky.
1917. *White.* Grown by Wilson & Co., Lebanon, Ky.
1918. *California Gold Chaff.* From Nashville, Tenn.
1919. *Fultz.* Grown by J. J. Hill & Son, Bowling Green, Ky.

From the exhibit of the Texas Pacific Railroad, at the Department of Agriculture.

1920. *Red.* Grown in Comac County, Texas.
1921. *Red.* Grown in Beaver County, Texas.
1922. *Red.* Grown in Traverse County, Texas.
1923. *Red.* Grown in Beaver County, Texas.
1924. *Amber.* Grown in Williamson County, Texas.
1925. *White.* Grown in El Paso County, Texas.
1926. *Amber.* Grown in Williamson County, Texas.
1927. *Amber.* Grown in Kaufman County, Texas.
1928. *Red.* Grown in Tarrant County, Texas.
1929. *Amber.* Grown in Traverse County, Texas.
1930. *Amber.* Grown in Dallas County, Texas.
1931. *Nicaraguan.* Grown in Milan County, Texas.
1932. *White.* Grown in El Paso County, Texas.
1933. *Red.* Grown in Tarrant County, Texas.
1934. *Red.* Grown in Traverse County, Texas.

From the exhibit of the Atchison, Topeka and Santa Fé Railroad, at the Department of Agriculture.

1935. *White.* Grown in Kansas.
1936. *Red.* Grown in Kansas.
1937. *White.* Grown in Kansas.
1938. *Red.* Grown in Kansas.
1939. *Red.* Grown in Kansas.
1940. *Red.* Grown in Kansas.
1941. *Amber.* Grown in Kansas.
1942. *White.* Grown in Kansas.
1943. *Amber.* Grown in Kansas.
1944. *Red.* Grown in Kansas.

From the Alabama Agricultural Mechanical College, at Auburn, Lee County, Alabama, through Prof. W. C. Stubbs.

The following wheats were grown on a poor and sandy soil, with no fertilizers, which had been in cotton three years without manure. They were sown about the end of November, 1882, and harvested early in June, 1883. They are named and described as follows:

Seed obtained in Philadelphia.

1801. *Lancaster Red.* Yield 450 pounds per acre, 7½ bushels. A bearded variety.

1802. *Smooth Mediterranean.* Yield 600 pounds, 10 bushels to the acre.

1803. *Tuscan Island.* Yield 690 pounds, 11½ bushels per acre. A bearded variety with long yellow heads; rusting slightly.

1804. *Rogers' Red.* Yield, 210 pounds, or 3½ bushels, per acre. Short head; rusted; very late, and mixed.

1805. *Dot.* Yield, 620 pounds, or 10⅓ bushels, per acre. Bearded; dark colored; long heads; no rust.

1806. *Clawson.* Yield, 310 pounds, or 5⅙ bushels. Beardless; rusted.

Seed from the Department.

1807. *Rice.* Yield, 520 pounds, or 8⅔ bushels, per acre. Rusted.

1808. *Bill Dallas.* Yield, 455 pounds, 7$\frac{35}{60}$ bushels, per acre. Rusted but slightly. Seed obtained in 1881 from the Department.

1809. *Tennessee Amber.* Yield, 320 pounds, or 5⅓ bushels, per acre. No rust; long, bright heads.

Seed from Philadelphia.

1810. *Emporium Scott.* Yield, 285 pounds, or 4⅔ bushels, per acre. No value. Rusted.

1811. *Lovell's New White.* Yield, 30 pounds, ½ bushel, per acre. No value. Rusted.

1812. *Washington Glass.* Yield, 170 pounds, 2⅚ bushels, per acre. Late, with rust.

1813. *Eureka White.* Yield, 105 pounds, or 1⅔ bushels, per acre. Late, with rust.

Seed long grown in Lee County.

1814. *Purple Straw.* Yield, 30 pounds, ½ bushel, per acre. Very early. No rust. Seed from Lowther, Lee County, Alabama.

1815. *Kilpatrick Rust Proof.* Yield, 175 pounds, or 2$\frac{55}{60}$ bushels, per acre. Long, bright heads. No rust.

Seed from W. S. Hughes, Athens, Ga.

1816. *Hughe's Rust Proof.* Yield, 440 pounds, or 7⅓ bushels, per acre. No rust. Long heads, and very bright.

Seed from Department.

1817. *Red Mediterranean.* Yield, 239½ pounds, or 4 bushels (nearly) per acre.

From Judge J. M. Robinson, Queen Anne County, Maryland.

1821. *Fultz.* Grown in 1883, from seed analyzed as No. 783, on corn ground, with application of complete commercial fertilizers.

1822. *Fultz.* Same as previous number, but from fallow ground.

Seed distributed by the Department in 1883.

1827. *Michigan Amber.* Grown near Springfield, Ohio, from the variety originally grown in Michigan.

1828. *Red Mediterranean.* Seed imported by the Department in the autumn of 1882, and partially distributed then. This sample is from another portion of the same lot, and is a duplicate of No. 784.

1841. *Black Sea.* This is an imported Russian variety distributed in the autumn of 1883.

1842. *McGhee's White.* A wheat originated and grown by J. O. McGhee, at Bellefont, Va. Distribution in the autumn of 1883.

From Christian Dale, Lemont, Centre County, Pennsylvania.

1831. *Burkholder.* "A variety which yields from 30 to 35 bushels per acre. It is considered the best wheat in the neighborhood."

1832. *Pennsylvania Amber.* "Yields as much as the Burkholder."

1833. *Fultz.* "Yields from 25 to 30 bushels per acre."

These wheats were grown on limestone soil.

From Hugh L. Wysor, Newbern, Pulaski County, Virginia.

1844. *Dallas.* From seed distributed by Department in 1881.

1845. *Fultz-Clawson.* Originated by Mr. Wysor.

These wheats were grown on a very light sandy soil which had no fertilizers. Had been in clover for four years. It was sown broadcast and plowed in. The Dallas is badly winter-killed in Virginia, three-fourths of it being lost. The remainder yielded 15 bushels per acre, weighing 68 pounds per bushel. The Fultz-Clawson is particularly suited to the northwest and middle wheat country.

CROPS FROM DEPARTMENT SEED, 1882–'83.

In June, 1883, a circular letter was addressed to a large number of correspondents who had received wheat from the Department from the seed distributed during the previous autumn. They were requested to return samples of the crop which they had been able to raise, and to answer the following questions:

1. Name.
2. Town, County, and State in which the wheat was grown.
3. Name of cereal.
4. Character of soil.
5. Fertilizers applied, and previous treatment of the soil.
6. Method of cultivation.
7. Yield per acre and weight per bushel.

In reply the following specimens and answers were received:

1807, 1808, 1817.

1. W. C. Stubbs.
2. Auburn, Lee County, Alabama.
3. 1807. *Rice Wheat.*
   1808. *Bill Dallas.* Distribution of 1881.
   1817. *Red Mediterranean.*

4. Sandy, and very poor.

5. No fertilizers. In cotton the past three years without manure.

6. Sandy, broken with one-horse turn-plow, seed sown broadcast by hand, slightly plowed in with scooter, and harrowed.

7. 1807. Rice, 520 pounds grain = 8⅔ bushels.
1808. Bill Dallas, 320 pounds grain = 5⅓ bushels.
1817. Red Mediterranean, 239 pounds grain = 4 bushels (nearly).

1818. *Red Mediterranean.*

1. Thos. P. McConnell.
2. Fayette, Fayette County, Alabama.
3. Red Mediterranean.
4. "Red clay with some sand."
5. No fertilizers, continuous cropping.
6. Sown broadcast and plowed in.
7. Seven bushels per acre, medium quality.

1819. *Red Mediterranean.*

1. C. B. Richardson.
2. Henderson, Rush County, Texas.
3. Red Mediterranean.
4. Reddish sandy.
5. Had been cultivated in turnips previous autumn. Wheat sown 13th January, cut down by hard freeze on the 22d January. The furrows had some cotton seed thrown in when the wheat was planted, and was cultivated by the sweep with two furrows only, once. It rusted, as all wheat I ever tried on my place has done, except the hard Nicaraguan.
7. The yield might have been 3 bushels per acre if it had been gathered.

1820. *Red Mediterranean.*

1. J. J. Barclay.
2. Lawrence County, Alabama.
3. Red Mediterranean.
4. Clay loam.
5. No fertilizers. In corn previous year.
6. Wheat sown after breaking ground on 15th October, and harrowed in.
7. 14 bushels; 60 pounds per bushel.

1823. *Red Mediterranean.*

1. B. J. Russell.
2. Milford, Baker County, Georgia.
3. Red Mediterranean.
4. Sandy, with clay subsoil.
5. Thoroughly pulverized, harrowed, and 200 pounds compost of cotton seed and cow manure well rotted applied to the acre. Seed and compost harrowed in together.

6. Sown broadcast and harrowed once in the spring.
7. Twenty-five bushels per acre.

1824. *White Mediterranean.*

1. B. F. Jarrell.
2. Rover, Bedford County, Pennsylvania.
3. White Mediterranean.

1825. *White Mediterranean.*

1. J. M. Stratton.
2. Benvanue, Clay County, Texas.
3. White Mediterranean.
4. Chocolate loam of Red River Valley.
5. No fertilizers.
6. Raised on millet stubble turned under, sown broadcast, and harrowed in.
7. Twenty bushels per acre.

1826. *Red Mediterranean.*

1. I. L. Goforth.
2. Bear Creek, Parker County, Texas.
3. Red Mediterranean.
4. "Gray lime, valley land."
5. No fertilizers; last year in wheat.
6. Mowed the land off in September; set fire to it and burnt clean in October; broke 3 inches deep; harrowed and sowed by drill; one bushel per acre,
7. Twenty-three and twenty-sixtieths bushels per acre; 61 pounds per bushel.

1829. *White Mediterranean.*

1. Lewis B. Thornton.
2. Tuscumbia, Colbert County, Alabama.
3. White Mediterranean.
4. High lands, rich and sandy. Fair sample of Tennessee Valley soil.
5 and 6. No fertilizers, except natural growth plowed in. Soil broken and wheat harrowed in late. Heavy rains till harvest.
7. Poor yield; 5 bushels per acre, which might weigh 60 pounds per bushel.

1830. *Osterey.*

1. John E. Dye.
2. Philadelphia, Hancock County, Indiana.
3. Osterey.
4. Heavy clay.
5. None.
6. The ordinary cultivation for wheat, except that this was drilled in corn.
7. About 10 bushels.

1834. *White Mediterranean.*

1. Irving Spence.
2. Snow Hill, Worcester County, Maryland.
3. White Mediterranean.
4. Light, rather sandy loam, with red clay subsoil.
5. No fertilizers applied. The land had raised a crop of Indian corn in 1882.
6. Wheat not received till November. Seeded last of that month. A succession of heavy rains followed; but for this would have had a good yield.
7. Seeded at the rate of one bushel to the acre, or three-fourths peck on three-sixteenths acre. Harvested 2 bushels. Weight, 60½ pounds per bushel.

1835. *Tennessee Amber.*

1836. *Rice.*

1. R. H. Query.
2. Shawnee Cape Girardeau County, Missouri.
3. Tennessee Amber and Rice.
4. Clay with humus, clovered.
5. No fertilizers. Second crop of last year's clover turned under about 1st September. Harrowed once before seeding.
6. No further cultivation.
7. Twenty-two and one-half bushels per acre, 62 pounds per bushel for the Tennessee Amber. One pound of Rice yielded 32 pounds of grain.

1837. *Rice.* 1882 crop. From seed of 1881.

1838. *Rice.* 1883 crop.

1. J. F. Brents.
2. Albany, Clinton County, Kentucky.
3. Rice.
4. Limestone, with some clay and gravel.

5 and 6. Sod turned under, cultivated in corn, corn cut, and a heavy sod of crab grass turned under. Wheat sown broadcast and harrowed.

7. Yield 1882, 12 bushels; in 1883, 8½ bushels; 63 grains to the head.

1839. *Red Mediterranean.*

1. W. D. H. Johnson.
2. Holton, Bibb County, Georgia.
3. Red Mediterranean.
4. Dark red clay loam.

5 and 6. No fertilizers. In corn previous year. Land broken 4 inches deep; wheat sown at the rate of one-half bushel per acre, and a drag run over it.

7 Rate per acre, 7 bushels. Weight, 57 pounds per bushel.

1840. *Rice.*

1. Thomas J. Mason.
2. London, Loudon County, Tennessee.
3. Rice. Second crop.
4. Gravelly soil, with clay subsoil. Second class land.

5, 6, and 7. No fertilizers used the first year. The land was in wheat the year before. It was turned, harrowed, and rolled, and the wheat then drilled in in the first week in October. It rusted, but there were harvested 8 bushels. This was drilled the second year on 8 acres and yielded in 1883 22½ bushels per acre.

1843. *White Mediterranean.*

1. Dr. Thomas W. Roane.
2. Covington, Tipton County, Tennessee.
3. White Mediterranean.
4. Dark loam. In cultivation thirty years. Medium fertility.
5. None applied. Land worked in cotton; grain seeded on the standing cotton stalks and put on with cultivator 1½ to 2 inches deep. Too late for wheat when seeded, and consequently rusted.
7. Eight bushels.

CHARACTER OF THE SPECIMENS.

The wheats included in the preceding list are with a few exceptions winter varieties. They are as a rule selected specimens, and are, if anything, rather above than below the average composition of the portions of the country from which they came. This is probably the case with the railroad exhibits where the fairest and finest grain has been collected for the display of the possible resources of the neighboring lands. In several instances, however, samples typical of the poorest wheat which is grown have been obtained, so that the extremes of production are well represented in the analyses. The seed which has been distributed by the Department has of course been from selected lots of grain, and together with the crops produced should be above the average of the country.

It is plain, then, that our averages which are deduced from the analyses of these samples will be favorable to a higher and better composition of the grain than actually exists.

METHOD OF ANALYSIS.

The samples of grain were immediately catalogued on their receipt and given a serial number by which they were known throughout the subsequent work upon them. Thirty or more grams were carefully cleaned from dirt, chaff, and foreign seed, and one hundred grains or kernels, selected at random, weighed, and the result recorded in grams and milligrams. The specimen was then rubbed up in a large iron mortar until the whole passed a sixty-mesh sieve, after which any iron which might have been introduced was removed by a magnet.

The fine flour was then analyzed as follows: One gram was dried in a porcelain crucible at 100°–105° C. until it ceased to lose weight. It was then burned in a gas muffle furnace and the ash weighed. In a few analyses, where the water falls below 8 per cent., the determinations may be a per cent. too low, owing to the fact that they were made in a drying oven with a temperature of only 95° C. They are so few in number as not to essentially modify the result.

For oil two grams were extracted in a continuous percolation apparatus with ether or petroleum ether, either solvent giving the same result. A battery of eighteen percolators allowed this work to be done very rapidly.

The fiber was obtained by alternate treatment with acid and soda in the usual manner, except that as the operation was conducted on a large steam bath of fifteen holes heated by live steam from our boiler, the length of time for digestion was increased to two hours and the strength of acid and soda to 5 per cent., the heat of the bath never raising the liquid above 95° C. Comparisons of this modification and the original Weende method, of actual boiling with weaker acid, showed the results to be concordant.

The nitrogen was determined by combustion with soda-lime, receiving the ammonia in fifth normal standard oxalic acid and titration with standard sodic hydrate which had been compared with normal hydrochloric acid standardized gravimetrically.

In several analyses after the extraction of the oil by ether, the residue was percolated with 80 per cent. alcohol in the same apparatus, removing sugar and soluble albuminoids which were separated by water. The albuminoids, of course, included the soluble portions of the gluten of the wheat, and the difference between the amount found in the alcohol extract and the total amount obtained by multiplying the nitrogen, found by combustion, by the factor 6.25, was stated as insoluble albuminoids, and consisted of the true albumen or cerealine and the gluten casein. After the extraction with alcohol the residue was rubbed up with water and allowed to stand a short time at ordinary temperatures. An aliquot portion of the filtrate, evaporated and dried, was stated as dextrine. It is a question, if this was ready formed in the grain to any extent; at times soluble starch was present, and there is a suspicion that both were formed by the action of some ferment on the starch in presence of water. It also, of course, contained a small amount of soluble albumen. As these determinations were very troublesome and did not furnish results which adequately repaid the labor involved, they were given up in the later analyses.

Determinations of specific gravity were attempted, but with such variable results that they were of slight value and were given over. Piknometers were used with water and with oil, but different samples from the same specimen of grain would apparently vary as much as quite different varieties.

ANALYSES OF WHEATS FROM OTHER SOURCES THAN THE DEPARTMENT OF AGRICULTURE.

No.	Name.	Locality.	Year.	Weight of 100 grains.	Water.	Ash.	Fat.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Analyst.
				Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
1	White extra	Michigan	1877		12.75	1.56	1.26	70.96	1.83	11.64	1.87	Atwater.
2	Red	Missouri	1877		13.52	1.55	1.47	69.95	1.72	11.79	1.89	Do.
3	Diehl	Michigan	1876		9.64	1.72		76.26		12.38	1.98	Kedzie.
4	do	do	1876		12.18	1.82		72.22		13.78	2.20	Do.
5	do	do	1876		12.68	1.77		73.74		11.81	1.89	Do.
6	do	do	1876		10.25	1.50		76.37		11.88	1.90	Do.
7	Soules	do	1876		11.02	1.73		75.44		11.81	1.89	Do.
8	do	British Columbia	1876		8.51	1.63		77.61		12.25	1.96	Do.
9	do	do	1876		11.22	2.09		74.81		11.88	1.90	Do.
10	do	Michigan	1876		10.07	1.89		74.59		13.45	2.16	Do.
11	Lincoln	do	1876		13.38	1.56		73.16		11.90	1.90	Do.
12	do	do	1876		10.78	1.75		76.09		11.38	1.82	Do.
13	Fultz	do	1876		11.45	1.74		75.22		11.59	1.86	Do.
14	do	do	1876		12.53	1.74		71.26		14.47	2.31	Do.
15	Treadwell	do	1876		12.69	1.71		73.10		12.50	2.00	Do.
16	do	do	1876		9.94	1.80		76.57		11.69	1.87	Do.
17	do	do	1876		10.00	1.76		76.36		11.88	1.90	Do.
18	Buckeye	do	1876		12.73	1.38		74.92		10.97	1.75	Do.
19	Tappahannock	do	1876		11.21	1.77		73.46		13.56	2.17	Do.
20	Lancaster	do	1876		11.93	1.82		72.25		14.00	2.24	Do.
21	Asiatic	do	1876		11.11	1.70		74.94		12.25	1.96	Do.
22	Gold Medal	do	1876		10.55	1.73		76.57		11.15	1.78	Do.
23	do	do	1876		10.12	2.00		74.82		13.00	2.08	Do.
24	Egyptian	do	1876		11.48	1.69		75.64		11.19	1.79	Do.
25	Clawson	do	1876		12.29	1.64		74.19		11.88	1.90	Do.
26	do	do	1876		11.30	1.74		76.02		10.94	1.75	Do.
27	do	do	1876		12.29	1.79		74.76		11.16	1.78	Do.
28	do	do	1876		10.36	1.64		76.19		11.81	1.89	Do.
29	do	do	1876		11.19	1.76		74.99		12.06	1.93	Do.
30	do	do	1876		11.09	1.64		74.89		12.38	1.98	Do.
31	do	do	1876		11.08	1.49		75.18		12.25	1.96	Do.
32	do	do	1876		10.43	1.70		75.18		12.69	2.03	Do.
33	do	do	1876		10.31	1.60		75.84		12.25	1.96	Do.
34	do	do	1876		13.00	1.79		73.84		11.37	1.82	Do.
35	do	Oregon	1876		12.99	1.77		74.74		10.50	1.68	Do.
36	Weeks	Michigan	1876		10.03	1.59		77.38		11.00	1.76	Do.
37	Powers	do	1876		10.85	1.70		75.42		12.03	1.92	Do.
38	Armstrong	do	1876		12.21	1.97		72.94		12.88	2.06	Do.
39	Tuscan	do	1876		13.77	1.72		73.14		11.37	1.82	Do.
40	Post	do	1876		10.27	1.58		76.90		11.25	1.78	Do.
41	Sonora Club	Oregon	1876		10.91	1.46		77.90		10.63	1.70	Do.
42	Minnesota No. 1	Minnesota	1882	2.732	12.34	1.59		70.98	2.03	13.06	2.09	Noyes.
43	Minnesota No. 2	do	1882	2.109	11.31	1.92		71.40	2.37	13.00	2.08	Do.
44	Minnesota No. 3	do	1882	2.037	11.85	1.97		70.12	2.50	13.56	2.17	Do.
45	Unmanured	Pennsylvania	1882		13.33	2.04	1.99	69.02	2.76	10.86	1.74	Jordan.
46	$P_2O_5 + K_2O$	do	1882		13.04	1.99	1.97	69.35	2.65	10.50	1.67	Do.
47	$P_2O_5 + K_2O + {}_1N$	do	1882		13.16	2.03	1.90	69.24	2.51	11.16	1.78	Do.
48	$P_2O_5 + K_2O + {}_2N$	do	1882		13.06	2.98	1.90	68.90	2.47	11.69	1.87	Do.
49	$P_2O_5 + K_2O + {}_3N$	do	1882		12.59	1.83	1.92	69.53	2.53	11.70	1.88	Do.
50	Manured	do	1882		12.41	2.09	1.89	70.10	2.37	11.04	1.76	Do.

Determinations of gluten mechanically were of more interest, and were made in all cases where the grain was received fresh from the harvest and in amount sufficient to allow it, but, as will be shown later, attempts with wheats which had been preserved a year or two led to erroneous results.

How far the methods and results can be depended on is, I think, shown in the following analyses of two samples of Red Mediterranean wheat taken from the same heap, the one in 1882, the other in 1883.

RED MEDITERRANEAN WHEAT.

	1882.	1883.
Water	9.83	9.88
Ash	1.70	1.62
Oil	2.21	2.06
Carbhydrates	73.73	73.80
Fiber	1.68	1.79
Albuminoids	10.85	10.85

It may be said, too, that no one engaged in these analyses had the slightest idea that the two specimens were duplicates. The work has been often duplicated in the matter of single determinations, which seemed irregular, and with the systematic methods of carrying it on it is known that the results can be depended on. Our facilities are at present equal to the analyses of twelve wheats a day, and it is hoped that specimens typical of several portions of the country, such as New York and California, which have not been examined, may be obtained for a continuation and extension of the work.

THE RESULTS.

The results which have been obtained by the methods just described are presented in the following tables, and for a clear exposition are arranged by States. The headings to the columns explain themselves, merely repeating that the weight of 100 grains or kernels is in grams and milligrams; that the *carbhydrates*, which include the sugar, dextrine, and starch of the grain, are found by difference between 100 per cent. and the amount of water, ash, oil, and fiber determined, and that the albumen or albuminoids is equivalent to the nitrogen multiplied by the factor 6.25.

A table of analyses which have been made by other investigators is presented, and the results contained therein have been distributed among the several States to which they belong, and properly accredited, in order that a complete list of the wheat analyses which have been made in this country might be collected in one place. The special railroad exhibits have, in addition, been arranged by themselves.

Serial number.	Name.	Spring or winter.	Color.	Consistency.	Year of growth.	Weight of 100 grains.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Analyst.
	CANADA:					*Grams.*	*Per ct.*	*P. ct.*	*P. ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
5	Victor	Winter	Yellow		1878	3.408	7.49	1.39	2.27	77.71	1.69	9.45	1.51	Department of Agriculture.
6	Silver Chaff	do			1878	3.686	8.93	1.58	2.44	75.41	1.75	9.89	1.58	Do.
11	Impr. Fife	Spring			1878		8.50	1.47	2.56	71.15	1.62	14.70	2.35	Do.
1358	Silver Chaff	Winter	Yellow		1879	3.597	11.05	1.90	2.28	73.27	1.70	9.86	1.57	Do.
1359	Midge Proof	do	White		1879	2.964	11.60	1.45	2.04	73.43	1.68	9.80	1.57	Do.
1360	Arnold's Victor	do	Yellow		1879	2.972	10.90	1.60	2.14	72.23	1.58	11.55	1.85	Do.
	VERMONT:													
763	Cross	Winter	Yellow	Glassy	1881	4.073	10.87	1.75	2.04	72 13	2.52	10.69	1.71	Department of Agriculture.
	NEW YORK:													
12	Champlain	Spring			1878		8.79	2.05	2.55	69.72	1.49	15.40	2.46	Department of Agriculture.
13	Defiance	do			1878		8.12	1.57	2.49	71.78	2.04	14.00	2.24	Do.
767	Landreth	Winter		Soft	1882	4.541	11.43	2.10	2.02	71.85	1.75	10.85	1.74	Do.
	PENNSYLVANIA:													
	Unmanured	Winter			1882		13.33	2.04	1.99	69.02	2.76	10.86	1.74	Jordan.
	$P_2O_5 + K_2O$	do			1882		13.04	1.99	1.97	69.85	2.65	10.56	1.67	Do.
	$P_2O_5 + K_2O + N$	do			1882		13.16	2.03	1.90	69.24	2.51	11.16	1.78	Do.
	$P_2O_5 + K_2O + 2N$	do			1882		13.06	2.98	1.90	67.96	2.47	11.69	1.87	Do.
	$P_2O_5 + K_2O + 3N$	do			1882		12.59	1.83	1.92	69.53	2.53	11.76	1.88	Do.
	Manured	do			1882		12.41	2.09	1.89	70.10	2.37	11.04	1.76	Do.
789	Champion Amber	do	Amber	Hard	1881	3.278	8.95	1.90	2.21	74.56	1.35	11.03	1.76	Department of Agriculture.
795	Lemon	do	Yellow	do	1881	3.417	8.35	1.90	2.51	70.13	1.53	15.58	2.49	Do.
797	Gold Medal	do	do	do	1881	3.076	8.60	1.80	2.37	76.05	1.38	9.80	1.57	Do.
799	German Amber	do	Amber	do	1881	2.938	7.60	1.70	2.64	75.98	1.05	11.03	1.76	Do.
803	Washington Glass	do	Yellow	do	1881	3.741	8.45	2.05	2.23	73.44	1.75	12.08	1.93	Do.
1280	Swamp	do	Red	do	1879	4.063	9.95	1.65	2.13	71.94	1.55	12.78	2.04	Do.
1282	Heiges Prolific	do	do	do	1879	3.097	10.06	1.15	1.77	75.07	1.33	10.68	1.71	Do.
1283	Glick	do	do	do	1879	3.958	11.55	1.80	2.10	70.50	1.80	12.25	1.96	Do.
1284	Champion Amber	do	do	do	1879	3.210	9.90	1.85	2.41	72.74	1.90	11.20	1.79	Do.
1285	Medit. White Chaff	do	do	do	1879	3.853	10.05	1.70	2.30	72.04	1.83	12.08	1.93	Do.
1286	Sandamika	do	do	do	1879	2.085	11.30	1.30	2.15	71.05	1.60	12.66	2.02	Do.
1287	Fultz	do	Amber	do	1879	3.275	11.40	.90	1.51	74.79	.90	10.56	1.68	Do.
1288	Gold Dust	do	Yellow	do	1879	2.526	11.45	.80	1.61	74.61	1.03	10.50	1.68	Do.
1289	Eureka	do	do	do	1879	3.238	10.50	1.35	2.14	72.86	1.60	11.55	1.85	Do.
1290	Washington Glass	do	do	do	1879	3.596	10.40	1.65	1.90	73.87	1.23	11.55	1.85	Do.
1291	Clawson	do	do	do	1879	3.120	10.60	1.60	2.09	72.10	2.23	11.38	1.82	Do.
1292	Gold Medal	do	do	do	1879	2.578	11.45	.90	1.39	74.66	.98	10.68	1.71	Do.
832	Mountain	do	White	Soft	1882	2.710	9.50	1.70	2.38	75.12	1.32	9.98	1.60	Do.

833	Mediterranean	do	Amber	Hard	1882	4.060	8.85	1.65	2.25	74.45	1.25	11.55	1.85	Department of Agriculture.
834	Fultz	do	do	do	1882	3.020	9.55	1.80	2.30	75.20	1.70	9.45	1.51	Do.
1352	Do	do	Red	Medium.	1879	3.473	11.00	1.40	2.11	72.38	1.73	11.38	1.82	Do.
1354	Clawson	do	Yellow	Hard	1879	4.292	11.35	1.90	1.90	71.90	1.75	11.20	1.79	Do.
764	Hybrid	do	Amber	do	1881	2.989	11.50	1.50	2.22	71.80	1.78	11.20	1.79	Do.
1831	Burkholder	do	White	Soft	1883	4.658	10.78	1.93	1.93	73.53	1.69	10.15	1.62	Do.
1832	Pennsylvania Amber	do	Amber	Medium.	1883	3.641	10.72	1.98	1.91	72.06	1.95	11.38	1.82	Do.
1833	Fultz	do	do	do	1883	3.882	11.45	1.97	1.46	69.61	1.86	13.65	2.18	Do.
	MARYLAND:													
9	Polish	Winter			1878		10.08	1.67	2.67	71.59	1.56	12.43	1.99	Department of Agriculture.
801	Rice	do	Red	Hard	1881	3.586	8.40	2.15	2.32	70.97	1.63	14.53	2.32	Do.
783	Fultz	do	Amber	do	1882	3.198	11.06	1.85	1.98	73.43	1.70	9.98	1.60	Do.
809	Rice	do	Red	do	1882	3.075	10.00	1.80	2.18	71.91	1.86	12.25	1.96	Do.
1353	Centennial Amber	do	Yellow	Medium.	1879	5.079	11.05	2.05	2.11	71.03	1.68	12.08	1.93	Do.
1355	Midge Proof	do	do	Soft	1879	3.077	9.45	1.35	1.93	74.79	1.63	10.85	1.74	Do.
1821	Fultz	do	Amber	Hard	1883	3.685	11.34	1.66	2.27	73.21	1.72	9.80	1.57	Do.
1822	Do	do	do	do	1883	3.602	11.38	1.64	1.55	72.99	1.59	10.85	1.74	Do.
1834	White Mediterranean	do	White	Soft	1883	3.472	11.92	1.63	1.77	70.30	2.30	12.08	1.93	Do.
	VIRGINIA:													
785	McGehee's Red	Winter	Red	Hard	1881	2.811	8.80	1.05	2.49	72.53	1.48	13.65	2.18	Department of Agriculture.
787	Finlay	do	do	do	1881	3.285	9.45	1.60	2.38	73.67	1.18	11.72	1.88	Do.
766	Hybrid	do	do	do	1882	3.652	11.54	1.65	2.00	70.30	1.73	12.78	2.04	Do.
780	Shenandoah, 1	do	do	do	1882	1.830	9.45	2.45	2.18	70.02	1.90	14.00	2.24	Do.
781	Shenandoah, 2	do	do	do	1882	2.655	11.15	1.60	2.56	72.76	1.78	10.15	1.62	Do.
782	Shenandoah, 3	do	do	do	1882	3.196	9.28	2.00	2.38	73.16	1.63	11.55	1.85	Do.
1361	Harrison	do	do	do	1879	3.708	11.14	1.86	2.46	71.11	1.70	11.73	1.88	Do.
1842	McGehee's White	do	White	Soft	1883	3.500	9.35	1.60	1.85	72.81	1.96	12.43	1.99	Do.
1844	Dallas	do	Red	Medium.	1883	4.137	12.26	1.58	1.83	69.59	1.96	12.78	2.04	Do.
1845	Fultz-Clawson	do	do	do	1883	4.208	12.10	1.80	2.01	71.84	1.75	10.50	1.68	Do.
807	Wysor	do			1881	3.796	9.25	1.55	2.16	72.71	1.73	12.60	2.02	Do.
	GEORGIA:													
791	Dallas	Winter	Amber	Hard	1881	4.023	7.95	2.15	2.48	73.17	1.65	12.60	2.02	Department of Agriculture.
793	Bennet	do		do	1881	3.218	8.05	2.05	2.22	72.30	1.38	14.00	2.24	Do.
769	Italian White	do		do	1882	4.627	11.22	1.70	2.68	73.47	1.48	9.45	1.51	Do.
770	Spring	Spring		do	1882	2.946	10.92	1.80	2.40	71.55	2.13	11.20	1.79	Do.
765	Purple Straw	Winter	Red	do	1882	4.512	10.49	2.30	2.12	73.46	1.48	10.15	1.62	Do.
1839	Red Mediterranean	do	do	do	1883	2.894	9.19	2.04	2.13	72.18	2.03	12.43	1.99	Do.
1823	Do	do	do	do	1883	2.834	12.20	1.66	2.09	69.57	1.88	12.60	2.02	Do.
	NORTH CAROLINA:													
811	Kivet	Winter.	Yellow.	Hard	1882	4.230	11.70	1.55	2.22	71.22	2.28	11.03	1.76	Department of Agriculture.
812	Do	do	do	do	1882	3.628	11.65	1.80	2.11	73.86	1.65	8.93	1.43	Do.
829	Do	do	do	do	1882	4.388	10.15	1.50	2.15	72.52	1.43	12.25	1.96	Do.
831	Do	do	do	do	1882	3.385	10.90	1.50	2.32	73.18	2.12	9.98	1.60	Do.
813	Rust Proof	do	Red	Medium.	1882	4.301	10.40	1.55	2.39	72.46	2.87	10.33	1.65	Do.
814	Do	do	do	do	1882	4.035	10.60	1.45	2.33	72.63	2.84	10.15	1.62	Do.
826	Do	do	do	do	1882	4.628	9.30	1.80	2.25	75.42	1.95	9.28	1.43	Do.
818	Baltimore	do	Yellow	do	1882	3.906	9.55	1.60	2.28	75.05	1.54	9.98	1.60	Do.
819	Do	do	do	do	1882	3.433	9.85	1.45	2.32	74.08	1.10	11.20	1.79	Do.
820	Do	do	do	do	1882	3.925	9.65	1.65	2.25	76.35	1.00	9.10	1.46	Do.
821	Do	do	do	do	1882	3.330	9.20	1.85	2.06	75.14	1.60	10.15	1.62	Do.
828	Do	do	do	do	1882	4.155	9.70	1.65	2.16	73.48	1.63	11.38	1.82	Do.

ANALYSES OF AMERICAN WHEATS ARRANGED BY STATES—CONTINUED.

Serial number.	Name.	Spring or winter.	Color.	Consistency.	Year of growth.	Weight of 100 grains.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Analyst.
	NORTH CAROLINA—Continued.					*Grams.*	*Per ct.*	*P. ct.*	*P. ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
824	Purple Straw	Winter	Red	Hard	1882	3.236	9.40	1.70	2.47	74.58	1.70	10.15	1.62	Department of Agriculture.
825	Do	do	do	do	1882	2.780	10.55	1.35	2.42	72.12	1.66	11.90	1.90	Do.
823	Davis	do	do	do	1882	3.756	8.45	1.75	2.28	73.26	2.53	11.73	1.88	Do.
822	Do	do	do	do	1882	3.285	8.35	1.60	2.43	76.50	.44	10.68	1.71	Do.
836	Do	do	do	do	1882	3.762	11.05	1.55	2.31	70.85	1.81	12.43	1.93	Do.
815	Earnhardt	Yellow	Soft		1882	3.951	16.32	1.30	2.10	74.07	1.63	9.98	1.60	Do.
816	Golden Premium	do	do	do	1882	4.374	16.66	1.70	2.03	74.44	1.54	9.63	1.54	Do.
817	Wintergreen	do	do	do	1882	3.567	9.40	1.20	2.34	76.17	1.44	9.45	1.51	Do.
827	Hicks Prolific	do	Red	Hard	1882	3.419	8.15	1.85	2.20	76.64	1.53	9.63	1.54	Do.
1356	White Australian	do	do	Medium.	1879	3.653	11.15	1.70	2.02	72.48	2.50	10.15	1.62	Do.
	ALABAMA:													
1861	Lancaster Red	Winter	Red	Medium.	1883	3.930	11.18	2.37	1.64	70.70	1.51	12.60	2.02	Department of Agriculture.
1802	Smooth Mediterranean	do	do	do	1883	3.955	10.42	2.01	2.30	72.23	1.61	11.38	1.82	Do.
1803	Tuscan Island	do	do	do	1883	4.055	16.52	2.03	2.69	72.40	1.51	10.85	1.74	Do.
1804	Rogers Red	do	do	Soft	1883	2.011	9.36	2.17	2.50	73.24	1.88	10.85	1.74	Do.
1805	Dot	do	do	Medium.	1883	3.710	16.21	2.18	2.37	72.85	1.54	10.85	1.74	Do.
1806	Clawson	do	Amber	Hard	1883	2.242	8.81	2.09	1.94	74.37	1.81	9.98	1.60	Do.
1807	Rice	do	Red	Medium.	1883	3.731	10.78	2.02	2.42	71.67	1.56	11.55	1.85	Do.
1808	Bill Dallas	do	Amber	Hard	1883	4.647	11 03	1.77	2.01	73.72	1.32	10.15	1.62	Do.
1809	Tennessee, Amber	do	do	Medium.	1883	3.486	10 84	1.96	2.07	72.57	1.53	11.03	1.76	Do.
1810	Emporium	do	Red	do	1883	2.794	11.62	1.91	2.04	70.93	1.66	11.90	1.90	Do.
1811	Lovell's New	do	Amber	do	1883	2.183	11.57	2.19	2.28	72.42	1.74	9.80	1.57	Do.
1812	Washington Glass	do	White	do	1883	2.166	10.84	2.12	2.42	73.02	1.80	9.80	1.57	Do.
1813	Eureka	do	Amber	do	1883	2.675	11.43	1.96	2.09	71.49	1.65	11.38	1.82	Do.
1814	Purple Straw	do	Lt. Red	Hard	1883	2.823	12.12	1.94	2.40	68.99	1.77	12.78	2.04	Do.
1815	Kilpatric Rust Proof	do	Red	V. Hard.	1883	4.265	12.36	1.88	2.13	69.86	1.49	12.25	1.96	Do.
1816	Hughes Rust Proof	do	do	Hard	1883	3.594	12.18	1.90	2.07	68.52	1.68	13.65	2.18	Do.
1817	Red Mediterranean	do	do	do	1883	4.077	9.68	2.01	2.22	72.29	1.55	12.25	1.96	Do.
	OHIO:													
4	Swamp	Winter			1878	3.976	7.63	1.84	2.41	74.99	1.54	11.59	1.86	Department of Agriculture.
1827	Michigan amber	do	Red	Hard	1883	3.637	11.30	1.93	1.40	71.80	1.78	11.73	1.88	Do.
	INDIANA:													
1830	Osterey	Winter	Yellow	Hard	1883	2.768	10.16	2.05	1.51	73.41	2.02	10.85	1.74	Department of Agriculture.
	MICHIGAN:													
	White Extra	Winter			1877		12.75	1.56	1.26	70.96	1.83	11.64	1.87	Atwater.
	Diehl	do			1876		9.64	1.72		76.26		12.38	1.98	Kedzie.

	Dichl	do			1876		12.18	1.82		72.22		13.78	2.20	Kedzie.
	Do	do			1876		12.68	1.77		73.74		11.81	1.89	Do.
	Do	do			1876		10.25	1.50		76.37		11.88	1.90	Do.
	Soules	do			1876		10.02	1.73		75.44		11.81	1.89	Do.
	Do	do			1876		10.07	1.89		74.59		13.45	2.16	Do.
	Lincoln	do			1876		13.38	1.56		73.16		11.90	1.90	Do.
	Do	do			1876		10.78	1.75		76.09		11.38	1.82	Do.
	Fultz	do			1876		11.45	1.74		75.22		11.59	1.86	Do.
	Do	do			1876		12.53	1.74		71.26		14.47	2.31	Do.
	Treadwell	do			1876		12.69	1.71		73.10		12.50	2.00	Do.
	Do	do			1876		9.94	1.80		76.57		11.69	1.87	Do.
	Do	do			1876		10.00	1.76		76.36		11.88	1.90	Do.
	Buckeye	do			1876		12.73	1.38		74.92		10.97	1.75	Do.
	Tappahanock	do			1876		11.21	1.77		73.46		13.56	2.17	Do.
	Lancaster	do			1876		11.93	1.82		72.25		14.00	2.24	Do.
	Asiatic	do			1876		11.11	1.70		74.94		12.25	1.96	Do.
	Gold Medal	do			1876		10.55	1.73		76.57		11.15	1.78	Do.
	Do	do			1876		10.12	2.00		74.82		13.06	2.08	Do.
	Egyptian	do			1876		11.48	1.69		75.64		11.19	1.79	Do.
	Clawson	do			1876		12.29	1.64		74.19		11.88	1.90	Do.
	Do	do			1876		11.30	1.74		76.02		10.94	1.75	Do.
	Do	do			1876		12.29	1.79		74.76		11.16	1.78	Do.
	Do	do			1876		10.36	1.64		76.19		11.81	1.89	Do.
	Do	do			1876		11.19	1.76		74.99		12.06	1.93	Do.
	Do	do			1876		11.09	1.64		74.89		12.38	1.98	Do.
	Do	do			1876		11.08	1.49		75.18		12.25	1.96	Do.
	Do	do			1876		10.43	1.70		75.18		12.69	2.03	Do.
	Do	do			1876		10.31	1.60		75.84		12.25	1.96	Do.
	Do	do			1876		13.00	1.79		73.84		11.37	1.82	Do.
	Weeks	do			1876		10.03	1.59		77.38		11.00	1.76	Do.
	Powers	do			1876		10.85	1.70		75.42		12.03	1.92	Do.
	Armstrong	do			1876		12.21	1.97		72.94		12.88	2.06	Do.
	Tuscan	do			1876		13.77	1.72		73.14		11.37	1.82	Do.
	Post	do			1876		10.77	1.58		76.90		11.25	1.78	Do.
1293	Silver Chaff	do	White	Soft	1879	4.196	10.25	1.00	1.70	75.00	1.20	10.85	1.75	Department of Agriculture.
1294	Louisiana	do	do	Medium	1879	3.738	10.30	1.60	2.07	73.73	1.80	10.50	1.68	Do.
1295	Jersey Red	do	Red	Hard	1879	3.981	9.05	1.70	2.17	73.17	2.18	11.73	1.88	Do.
1296	Powers	do	White	do	1879	3.611	9.70	1.05	1.79	75.91	1.05	10.50	1.68	Do.
1297	Dot	do	Red	do	1879	4.535	9.70	1.90	2.23	71.94	1.80	12.43	1.99	Do.
1298	Michigan Wick	do	White	Medium	1879	3.931	9.65	1.65	2.09	73.88	2.05	10.68	1.71	Do.
1299	Schaeffer	do	Yellow	Medium	1879	4.269	9.35	1.65	2.12	73.80	1.88	11.20	1.79	Do.
1340	Lancaster Red	do	Red	Hard	1879	4.625	11.25	1.80	2.21	69.96	1.83	12.95	2.07	Do.
1341	Velvet Chaff	do	Yellow	do	1879	4.135	11.50	2.05	2.17	68.60	1.68	14.00	2.24	Do.
1342	Shumaker	do	Amber	do	1879	4.525	11.10	1.35	1.97	71.38	1.60	12.60	2.02	Do.
1343	Armstrong	do	Yellow	do	1879	3.983	10.60	1.70	2.30	72.62	2.10	10.68	1.71	Do.
1344	Muskingum	do	Red	Medium	1879	4.010	11.35	1.40	2.16	70.59	1.90	12.60	2.02	Do.
1345	Mediterranean	do	do	do	1879	4.902	10.90	1.25	1.98	69.41	1.23	15.23	2.44	Do.
1346	Red Russian	do	do	Soft	1879	4.809	10.40	2.05	2.31	71.38	1.78	12.08	1.93	Do.
1347	Dichl	do	White	do	1879	3.402	10.90	1.75	2.14	73.11	1.60	10.50	1.68	Do.
1348	Clawson	do	Yellow	Medium	1879	4.096	11.40	1.65	2.20	72.12	1.95	10.68	1.71	Do.
1349	Jennings	do	White	Soft	1879	3.926	11.65	1.85	1.99	70.61	1.65	12.25	1.96	Do.

ANALYSES OF AMERICAN WHEATS ARRANGED BY STATES—CONTINUED.

Serial number.	Name.	Spring or winter.	Color.	Consistency.	Year of growth.	Weight of 100 grains.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Analyst.
	MICHIGAN—Continued.					*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	Department of Agriculture.
1350	Buckeye	Winter	Yellow	Soft	1879	4.106	11.55	1.45	1.89	70.73	1.95	12.43	1.99	Do.
1351	Trnmp	do	do	do	1879	4.301	10.95	1.70	1.95	72.02	2.00	11.38	1.82	Do.
754	Shumaker	do	Amber	Hard	1882	4.377	10.05	2.08	2.45	74.01	2.28	9.13	1.46	Do.
755	Clawson	do	Yellow.	Medium.	1882	3.856	11.20	1.97	2.18	71.59	2.35	10.69	1.71	Do.
	KENTUCKY:													
1280	Fultz	Winter	Red	Hard	1882	3.666	10.55	1.40	2.30	71.87	1.98	11.90	1.90	Department of Agriculture.
1837	Rice	do	do	do	1883	3.465	10.53	1.79	1.99	69.55	1.61	14.53	2.32	Do.
1838	Do	do	do	do	1883	3.645	10.96	1.52	1.94	69.89	1.69	14.00	2.24	Do.
1910	Fultz	do	Amber	do	(?)	3.274	12.44	1.76	1.87	69.44	1.71	12.78	2.04	Do.
1913	Odessa	do	do	Soft	(?)	3.146	10.08	1.76	1.64	71.75	2.27	11.90	1.90	Do.
1916	German Amber	do	do	Medium.	(?)	3.539	9.86	1.78	1.79	69.95	2.44	14.18	2.27	Do.
1917	White	do	White	Soft	(?)	3.395	9.94	2.07	1.65	71.22	2.34	12.78	2.04	Do.
1919	Fultz	do	Amber	Medium.	(?)	3.502	11.68	1.88	1.80	69.26	2.25	13.13	2.10	Do.
	TENNESSEE:													
805	Swamp	Winter	Red	Hard	1881	3.669	7.10	2.10	2.08	70.24	1.85	16.63	2.66	Department of Agriculture.
775	Tennessee Amber	do	Amber	do	1882	3.294	9.90	1.85	2.09	72.78	1.48	11.90	1.90	Do.
776	Spark's Swamp	do	do	do	1882	3.551	10.24	1.80	2.31	72.37	1.73	11.55	1.85	Do.
1840	Rice	do	Red	do	1883	3.734	9.19	2.04	2.15	74.40	2.24	9.98	1.60	Do.
1824	White Mediterranean	do	White	Soft	1883	2.469	10.92	2.38	1.90	66.71	2.86	15.23	2.44	Do.
1843	Do	do	do	do	1883	2.138	10.64	2.10	2.04	72.87	2.20	10.15	1.62	Do.
775	Tennessee Amber	do	Amber	Medium.	1883	3.204	9.90	1.85	2.09	72.78	1.48	11.90	1.90	Do.
1909	Do	do	Yellow	Soft	(?)	2.448	11.10	1.62	2.06	70.95	1.67	12.60	2.02	Do.
1911	Red	do	Amber	Hard	(?)	2.568	11.85	1.90	2.00	71.57	1.83	10.85	1.74	Do.
1912	Bearded	do	do	Soft	(?)	3.326	11.30	1.90	2.12	69.71	2.54	12.43	1.99	Do.
1914	Fultz	do	do	Medium.	(?)	2.761	10.64	1.60	2.16	70.87	2.13	12.60	2.02	Do.
1915	Do	do	do	do	(?)	3.737	10.66	1.92	1.87	71.11	2.36	12.08	1.93	Do.
1918	California Gold Chaff	do	do	Hard	(?)	3.301	10.26	1.72	1.69	68.72	2.21	15.40	2.46	Do.
835	Swamp	do	do	do	1882	3.990	8.95	1.65	2.20	73.60	2.70	11.90	1.90	Do.
	DAKOTA:													
768	Castle Fife	Winter		Hard	1882	3.513	10.98	2.20	2.11	72.20	1.83	10.68	1.71	Department of Agriculture.
810	Scotch Fife	Spring		do	1882	2.755	10.08	1.80	2.25	69.69	1.83	14.35	2.30	Do.
	MINNESOTA:													
	Minnesota Fife, No. 1			Hard	1882	2.732	12.34	1.59	.....	.....	2.03	13.06	2.09	Noyes.
	Minnesota Fife, No. 2			do	1882	2.109	11.31	1.92	.....	.....	2.37	13.00	2.08	Do.
	Minnesota Fife, No. 3			do	1882	2.037	11.85	1.97	.....	.....	2.50	13.56	2.17	Do.
1900	Egyptian		Yellow	do	(?)	3.828	10.44	1.95	1.77	70.99	1.55	13.30	2.13	Department of Agriculture.

1901	Scotch Fife	Amber	Medium.	(?)	3.154	10.62	1.90	2.08	72.24	2.31	10.85	1.74	Do.
1902	Red Fern	do	do	(?)	3.192	11.71	1.91	2.16	68.84	2.20	17.15	2.74	Do.
1903	Fife	Yellow	Soft	(?)	3.046	10.31	1.79	2.16	69.37	2.89	13.48	2.16	Do.
1904	Old Settlers	Red	Medium.	(?)	3.364	10.10	1.57	1.83	72.26	1.81	12.43	1.99	Do.
1905	Red Fern	do	do	(?)	3.242	10.08	1.43	2.19	72.09	1.96	12.25	1.96	Do.
1906	Fife	Amber	Soft	(?)	3.116	11.34	1.50	2.02	71.77	1.82	11.55	1.85	Do.
1907	Golden Drop	do	do	(?)	3.545	11.10	1.53	1.89	71.97	1.96	11.55	1.85	Do.
1908	White Fife	White	Medium.	(?)	3.699	9.70	1.80	2.19	73.05	1.88	11.38	1 82	Do.
	MISSOURI:												
	Red	Winter	Red	Hard	(?)	.....	13.52	1.55	1.47	69.95	1.72	11.79	1.89	Atwater.
3	Yellow	do	Yellow	do	1878	3.098	7.69	1.91	2.11	75.17	1.53	11.59	1.86	Department of Agriculture.
756	Fultz	do	Red	do	1879	3.455	10.28	1.80	2.28	72.86	2.28	10.50	1.68	Do.
757	Shumaker	do	do	do	1879	3.349	8.64	1.99	2.33	72.11	2.49	12.44	1.99	Do.
758	Zimmerman	do	do	do	1879	3.867	9.18	2.01	2.35	72.51	2.57	11.38	1.82	Do.
759	Clawson	do	Amber	do	1879	3.860	9.18	1.91	2.16	73.28	2.28	11.19	1.79	Do.
760	Russian, No. 2	do	Yellow	do	1879	3.475	8.43	2.09	2.23	73.53	2.72	11.00	1.76	Do.
761	Smooth Mediterranean	do	Amber	do	1879	3.583	9.45	1.89	1.80	72.43	2.68	11.75	1.88	Do.
762	Silver Chaff	do	do	do	1879	3.492	10.99	2.22	2.42	70.89	2.29	11.19	1.79	Do.
778	Osterey	do		do	1882	3.340	11.48	1.90	2.36	70.95	1.88	11.43	1.92	Do.
1836	Rice	do	Red	do	1883	.....	9.36	1.88	2.37	70.62	1.77	14.00	2.24	Do.
1835	Tennessee Amber	do	Amber	do	1883	.....	9.41	1.88	2.35	74.01	1.85	10.50	1.68	Do.
	KANSAS:													
1935			White	Soft	(?)	3.424	11.58	1.72	1.98	71.87	2.01	10.85	1.74	Department of Agriculture.
1936			Red	Medium.	(?)	3.332	11.77	1.84	2.07	71.15	1.97	11.20	1.79	Do.
1937			White	Soft	(?)	3.349	11.60	1.78	2.04	72.19	1.89	10.50	1.68	Do.
1938			Red	Hard	(?)	2.995	11.36	1.54	1.91	70.18	2.76	12.25	1.96	Do.
1939			do	Medium.	(?)	3.331	11.57	1.47	2.02	72.29	1.62	11.03	1.76	Do.
1940			do	do	(?)	3.405	12.38	1.58	1.83	71.96	1.75	10.50	1.68	Do.
1941			Amber	do	(?)	2.975	12.27	1.61	2.01	70.12	2.09	11.90	1.90	Do.
1942			White	Soft	(?)	3.390	12.10	1.70	1.96	71.73	1.66	10.85	1.74	Do.
1943			Amber	Medium.	(?)	2.881	11.62	1.66	2.12	70.87	3.05	10.68	1.91	Do.
1944			Red	do	(?)	2.956	11.76	1.50	1.83	71.15	2.03	11.73	1.88	Do.
	TEXAS:													
1920			Red	Medium.	(?)	2 606	10.64	1.92	2.39	70.23	2.39	12.43	1.99	Department of Agriculture.
1921			do	Hard	(?)	2.663	9 70	1.66	2.56	71.14	1.99	12.95	2.07	Do.
1922			do	do	(?)	2.708	9.26	2.18	1.94	70.19	2.08	14.35	2.30	Do.
1923			do	do	(?)	2.826	9.36	1.64	2.15	70.95	2.25	13.65	2.18	Do.
1924			Amber	do	(?)	2.699	9.50	1.60	2.00	73.86	2.01	11.03	1.76	Do.
1925			White	Soft	(?)	3.937	9.55	1.94	1.89	71.13	1.89	13.65	2.18	Do.
1926			Amber	do	(?)	2.409	9.66	2.43	1.86	69.68	2.19	14.18	2.27	Do.
1927			do	Hard	(?)	2.631	10.26	1.86	1.96	70.37	1.90	13.65	2.18	Do.
1928			Red	Medium.	(?)	2.690	10.24	1.72	1.76	71.46	2.22	12.60	2.02	Do.
1929			Amber	do	(?)	2.608	10.00	1.52	1.92	70.55	2.01	14.00	2.24	Do.
1930			do	Soft	(?)	2.714	9.62	1.68	1.72	70.79	2.19	14.00	2.24	Do.
1931	Nicaraguan		Yellow	do	(?)	3.136	10.00	1.72	1.83	69.55	2.20	14.70	2.35	Do.
1932			White	do	(?)	4.740	10.28	1.80	2.46	72.73	2.05	10.68	1.71	Do.
1933			Red	do	(?)	2.622	10.04	1.76	2.46	70.95	2.19	12.60	2.02	Do.
1934			do	Medium.	(?)	2.561	10.00	1.76	2.83	70.78	2.03	12.60	2.02	Do.
1819	Red Mediterranean	Winter	do	Hard	1883	3.525	8.88	2.02	2.34	69.44	2.09	15.23	2.44	Do.
1826	Do	do	do	do	1883	3.320	11.61	1.69	2.08	70.62	1.92	12.08	1.93	Do.
1825	White Mediterranean	do	White	Soft	1883	3.700	12.05	2.02	1.59	68.95	1.91	13.48	2.16	Do.
1610	Nicaraguan	do	Glassy	Hard	1882	.....	9.94	1.58	2.29	72.75	1.71	11.73	1.88	Do.

Serial number.	Name.	Spring or winter.	Color.	Consistency.	Year of growth.	Weight of 100 grains.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Analyst.
	COLORADO:					*Grams.*	*Per ct.*	*Pr. ct.*	*Pr. ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
719	Hybrid, No. 10	Winter	Amber	Hard	1881	.....	9.72	2.28	2.16	70.77	1.32	13.75	2.20	Department of Agriculture.
720	Hybrid, No. 15	do	Red	do	1881	.....	10.07	1.93	2.68	71.50	1.57	12.25	1.96	Do.
721	Hybrid, No. 16	do	do	Medium.	1881	4.824	9.53	2.04	2.54	72.52	1.62	11.75	1.88	Do.
722	Hybrid, No. 17	do	do	Hard	1881	5.137	9.93	2.07	3.93	68.86	1.59	13.62	2.18	Do.
723	Hybrid, No. 18	do	.....	.....	1881	.....	9.74	2.19	1.58	71.95	1.60	12.94	2.07	Do.
724	Hybrid, No. 19	do	.....	.....	1881	.....	10.45	2.54	2.19	70.59	1.79	12.44	1.99	Do.
725	Hybrid, No. 20	do	do	.....	1881	.....	10.57	3.57	2.32	69.62	1.67	12.25	1.96	Do.
726	New South Wales Seed	do	Yellow	Medium.	1881	4.657	9.47	2.18	2.40	71.78	1.55	12.62	2.02	Do.
727	Centennial	do	.....	.....	1881	.....	9.66	2.35	2.00	72.83	1.10	12.06	1.93	Do.
728	El Dorado	do	Yellow	Hard	1881	4.702	10.55	2.24	2.43	71.93	1.10	11.75	1.88	Do
729	White Mexican	do	.....	.....	1881	.....	9.91	2.60	1.89	70.27	1.52	13.81	2.21	Do.
730	Judkin	do	Red	Hard	1881	.....	9.75	2.57	2.42	71.31	1.70	12.25	1.96	Do.
731	Australian	do	Yellow	Soft	1881	5.506	9.78	1.85	2.23	73.50	1.45	11.19	1.79	Do.
732	Fountain	do	do	Hard	1881	5.100	10.58	2.70	2.15	69.63	1.32	13.62	2.18	Do.
733	Perfection	do	do	do	1881	5.536	9.93	1.90	2.32	70.03	1.55	14.18	2.27	Do.
734	Russian	do	Red	Soft	1881	4.131	9.55	1.99	2.62	69.86	1.49	14.49	2.31	Do.
735	Rio Grando	do	do	do	1881	5.906	9.51	2.08	2.96	68.97	1.79	14.69	2.35	Do.
736	Tousello	do	Yellow	Medium.	1881	5.214	10.23	2.10	2.35	70.17	1.65	13.50	2.16	Do.
737	German Fife	do	Red	Soft	1881	5.368	10.42	2.31	2.79	67.94	1.48	15.06	2.41	Do.
738	Oregon Club	do	Yellow	do	1881	4.434	9.59	1.91	2.19	72.46	1.60	12.25	1.96	Do.
739	Sonora	do	do	do	1881	4.739	10.17	2.02	2.13	70.10	1.40	14.18	2.27	Do.
740	Imperial Fife	do	do	Hard	1881	4.147	9.48	2.64	2.31	68.00	1.63	15.94	2.55	Do.
741	Lost Nation	do	Red	Medium.	1881	3.851	10.24	2.17	2.99	69.93	1.74	12.93	2.07	Do.
742	Pringles, No. 6	do	Yellow	do	1881	5.145	9.89	2.13	2.52	70.63	1.70	13.13	2.10	Do.
743	Pringles, No. 7	do	Amber	Hard	1881	4.636	9.89	2.23	2.20	68.65	1.78	15.25	2.44	Do.
744	Clawson	do	Yellow	Soft	1881	4.565	10.14	1.94	2.31	72.26	1.60	11.75	1.88	Do.
745	Hedge Row	do	do	Medium.	1881	4.072	9.07	2.08	2.11	71.50	1.62	13.62	2.18	Do.
746	Do	Spring	Amber	Hard	1881	4.499	9.17	2.59	2.09	71.88	1.33	12.94	2.07	Do.
747	White Chaff	Winter	Red	Soft	1881	4.214	9.57	2.03	2.44	69.64	2.18	14.04	2.25	Do.
748	Triticum	do	Yellow	Hard	1881	5.754	10.02	2.67	2.65	69.53	1.51	13.62	2.18	Do.
749	Durun Russia	do	Amber	do	1881	5.924	9.91	2.32	2.09	68.98	1.54	15.25	2.44	Do.
750	Doty	do	Red	Soft	1881	4.373	9.41	2.35	2.50	69.94	1.80	14.00	2.24	Do.
751	Meekins	do	do	do	1881	5.193	9.38	2.53	2.97	68.38	1.59	15.15	2.43	Do.
786	McGehee's Red	do	do	Hard	1882	4.159	7.85	1.85	1.97	72.53	1.80	14.00	2.24	Do.
788	Finley	do	do	do	1882	4.125	9.39	1.85	2.36	72.16	1.73	12.60	2.02	Do.
790	Champion Amber	do	Amber.	do	1882	4.347	8.20	2.21	2.47	73.68	1.55	11.90	1.90	Do.

792	Dallas	do	Red	do	1882	4.670	10.05	1.85	2.46	69.38	1.73	14.53	2.32	Do.
794	Bennet	do	do	do	1882	3.976	7.85	2.20	2.58	71.67	2.05	13.65	2.18	Do.
796	Lemon	do	do	do	1882	4.335	8.45	2.05	2.14	73.25	1.68	12.43	1.99	Do.
798	Gold Medal	do	do	do	1882	4.375	9.25	1.80	2.26	72.71	1.73	12.25	1.96	Do.
800	German Amber	do	Amber	Medium	1882	4.027	8.80	1.80	2.42	72.80	1.75	12.43	1.99	Do.
802	Rice	do	Red	Hard	1882	4.103	8.50	2.10	2.39	70.86	1.97	14.18	2.27	Do.
804	Washington Glass	do	do	do	1882	4.450	8.60	1.95	2.41	74.31	1.18	11.55	1.85	Do.
806	Swamp	do	do	do	1882	4.423	10.15	2.05	2.29	69.31	1.85	14.35	2.30	Do.
808	Wysor	do	do	do	1882	4.609	8.55	2.25	2.20	72.27	2.13	12.60	2.02	Do.
	OREGON:													
	Clawson	Winter					12.99	1.77		74.74		10.50	1.68	Kedzie.
	Senora Club	(?)					10.91	1.46		77.00		10.63	1.70	Do.
10	White	Winter			1878		9.52	1.57	1.69	77.11	1.53	8.58	1.37	Department of Agriculture.
14	Chili Club	Spring			1878		7.90	1.56	2.33	78.66	1.41	8.14	1.30	Do.
15	Noah Island	do			1878		9.64	2.00	2.06	75.18	1.92	9.20	1.47	Do.
772	Hudson Bay	Winter			1882	4.253	10.97	1.75	2.31	74.51	1.88	8.58	1.37	Do.
773	Velvet Chaff	do	White		1882	5.144	10.92	1.95	1.80	75.60	1.68	8.05	1.29	Do.
774	Red Chaff	Spring	Red		1882	5.745	10.68	2.20	2.16	74.91	1.65	8.40	1.34	Do.
7	Foizy	Winter					8.98	1.73	2.28	77.36	1.25	8.40	1.34	Do.
8	Brazilian	do					9.29	1.95	1.99	76.13	1.17	9.47	1.51	Do.
	BRITISH COLUMBIA:													
	Soules				1876		8.51	1.63		77.61		12.25	1.96	Kedzie.
	Do				1876		11.22	2.09		74.81		11.88	1.90	Do.

ANALYSES OF WHEATS,—RAILROAD EXHIBITS.

Exhibit of Saint Paul, Minneapolis and Manitoba Railroad.

Serial number.	Name.	Locality.	Color.	Consistency.	Weight of 100 grains.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.
					Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1900	Egyptian		Yellow	Hard	3.828	10.44	1.95	1.77	70.99	1.55	13.30	2.13
1901	Scotch Fife		Amber	Medium	3.154	10.62	1.90	2.08	72.24	2.31	10.85	1.74
1902	Red Fern		do	do	3.192	11.74	1.91	2.16	64.84	2.20	17.15	2.74
1903	Fife		Yellow	Sott	3.046	10.31	1.79	2.16	69.37	2.89	13.48	2.16
1904	Old Settler		Red	Medium	3.364	10.10	1.57	1.83	72.26	1.81	12.43	1.99
1905	Red Fern		do	do	3.242	10.08	1.43	2.19	72.09	1.96	12.25	1.96
1906	Fife		Amber	Soft	3.116	11.34	1.50	2.02	71.77	1.82	11.55	1.85
1907	Golden Drop		do	do	3.545	11.10	1.53	1.89	71.97	1.96	11.55	1.85
1908	White Fife		White	Medium	3.699	9.70	1.80	2.19	73.05	1.88	11.38	1.82

Exhibit of Louisville and Nashville Railroad.

1909	Amber	Henry County, Tennessee	Yellow	Soft	2.948	11.10	1.62	2.06	70.95	1.67	12.60	2.02
1910	Fultz	Henderson County, Kentucky	Amber	Medium	3.274	12.44	1.76	1.87	69.44	1.71	12.78	2.04
1911	Red	Henry County, Tennessee	do	Hard	2.568	11.85	1.90	2.00	71.57	1.83	10.85	1.74
1912	Bearded	Carroll County, Tennessee	do	Soft	3.326	11.30	1.90	2.12	69.71	2.54	12.43	1.99
1913	Odessa	Kentucky	do	do	3.146	10.68	1.76	1.64	71.75	2.27	11.90	1.90
1914	Fultz	Montgomery County, Tennessee	do	Medium	2.761	10.64	1.60	2.16	70.87	2.13	12.60	2.02
1915	Do	Montgomery County, Tennessee	do	do	3.737	10.66	1.92	1.87	71.11	2.36	12.08	1.93
1916	German Amber	Kentucky	do	do	3.539	9.86	1.78	1.79	69.95	2.44	14.18	2.27
1917	White	Kentucky	White	Soft	3.395	9.94	2.07	1.65	71.22	2.34	12.78	2.04
1918	California Gold Chaff	Tennessee	Amber	Hard	3.301	10.26	1.72	1.69	68.72	2.21	15.40	2.46
1919	Fultz	Kentucky	do	Medium	3.502	11.68	1.88	1.80	69.26	2.25	13.13	2.10

Exhibit of Texas and Pacific Railroad.

1920		Comac County, Texas	Red	Medium	2.696	10.64	1.92	2.39	70.23	2.39	12.43	1.99
1921		Beaver County, Texas	do	Hard	2.663	9.70	1.66	2.56	71.14	1.99	12.95	2.07
1922		Traverse County, Texas	do	do	2.708	9.26	2.18	1.94	70.19	2.08	14.35	2.30
1923		Beaver County, Texas	do	do	2.826	9.36	1.64	2.85	70.95	2.25	13.65	2.18
1924		Williamson County, Texas	Amber	do	2.699	9.50	1.60	2.00	73.86	2.01	11.03	1.76

1925		El Paso County, Texas	White	Soft	3.937	9.50	1.94	1.89	71.13	1.89	13.65	2.18
1926		Williamson County, Texas	Amber	do	2.409	9.66	2.43	1.86	69.68	2.19	14.18	2.27
1927		Kaufman County, Texas	do	Hard	2.631	10.26	1.86	1.96	70.37	1.90	13.65	2.18
1928		Tarrant County, Texas	Red	Medium	2.690	10.24	1.72	1.76	71.46	2.22	12.60	2.02
1929		Traverse County, Texas	Amber	do	2.608	10.00	1.52	1.92	70.55	2.01	14.90	2.24
1930		Dallas County, Texas	do	Soft	2.714	9.62	1.68	1.72	70.79	2.19	14.00	2.24
1931	Nicaraguan	Milan County, Texas	Yellow	Hard	3.136	10.00	1.72	1.83	69.55	2.20	14.70	2.35
1932		El Paso County, Texas	White	Soft	4.740	10.28	1.80	2.46	72.73	2.05	10.68	1.71
1933		Tarrant County, Texas	Red	do	2.622	10.04	1.76	2.46	70.95	2.19	12.60	2.02
1934		Traverse County, Texas	do	Medium	2.561	10.00	1.76	2.83	70.78	2.03	12.60	2.02

Exhibit of Atchison, Topeka and Santa Fé Railroad.

1935			White	Soft	3.424	11.58	1.72	1.98	71.87	2.01	10.85	1.74
1936			Red	Medium	3.332	11.77	1.84	2.07	71.15	1.97	11.20	1.79
1937			White	Soft	3.349	11.60	1.78	2.04	72.19	1.89	10.50	1.68
1938			Red	Hard	2.995	11.36	1.54	1.91	70.18	2.76	12.25	1.96
1939			do	Medium	3.331	11.57	1.47	2.02	72.29	1.62	11.03	1.76
1940			do	do	3.405	12.38	1.58	1.83	71.96	1.75	10.50	1.68
1941			Amber	do	2.975	12.27	1.61	2.01	70.12	2.09	11.90	1.90
1942			White	Soft	3.390	12.10	1.70	1.96	71.73	1.66	10.85	1.74
1943			Amber	Medium	2.881	11.62	1.66	2.12	70.87	3.05	10.68	1.71
1944			Red	do	2.956	11.76	1.50	1.83	71.15	2.03	11.73	1.88

AVERAGES.

From the data contained in the previous tables, excluding the incomplete analyses of Kedzie and Noyes, a table of averages has been calculated, which includes—

1. The average composition of the wheats of America.
2. The average composition of the wheats of the Atlantic and Gulf States from Canada to Alabama, inclusive.
3. The average composition of the wheat of the Middle West limited by the Mississippi River.
4. The average composition of the wheats of the West beyond the Mississippi, including Texas, Colorado, Kansas, Missouri, and Minnesota.
5. The average composition of the wheats of the Pacific slope, unfortunately only represented by eight samples from Oregon.
6. The average composition of the wheats grown in each of the States where as many as six specimens have been analyzed.

AVERAGE COMPOSITION OF AMERICAN WHEATS.

No. of analyses.		Weight of 100 grains.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Heaviest 100 grains.	Lightest 100 grains.	Highest albuminoids.	Lowest albuminoids.
		Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Grams.*	*Grams.*	*Per ct.*	*Per ct.*
260	United States and Canada	3.638	10.27	1.84	2.16	71.98	1.80	11.95	1.91	5.924	1.830	17.15	8.05
108	Atlantic and Gulf States	3.464	10.42	1.75	2.17	72.61	1.72	14.33	1.81	5.079	1.830	15.58	9.45
47	The Middle West	3.607	10.51	1.76	2.01	71.67	1.90	12.15	1.94	4.902	2.138	16.63	10.15
07	West of the Mississippi	3.806	10.04	1.99	2.22	71.12	1 87	12.76	2 04	5.924	2.561	17.15	10.15
8	The Pacific coast	5.044	9.74	1.84	2.08	76.18	1.56	8.60	1.37	(5.745)	(4.253)	9.47	8.05
6	Canada	3.325	9.74	1.56	2.29	73.87	1.67	10.87	1.74	3.686	2.964	14.70	9.45
32	Pennsylvania	3.373	10.72	1.67	2.05	72.45	1.73	11.38	1.82	4.658	2.035	15.58	9.45
9	Maryland	3.597	10.52	1.75	2.09	72.25	1.74	11.65	1.86	5.079	3.075	14.53	9.80
11	Virginia	3.343	10.34	1.70	2.21	71.87	1.71	12.71	1.95	4.208	1.830	14.00	10.15
7	Georgia	3.579	10.00	1.96	2.30	72.24	1.72	11.78	1.89	4.627	2.834	14.00	9.45
22	North Carolina	3.776	10.03	1.59	2.25	73.94	1.76	10.43	1.67	4.628	2.780	12.43	8.93
17	Alabama	3.314	10.94	2.03	2.21	71.84	1.62	11.36	1.79	4.647	2.011	13.65	9.80
	Michigan (Kedzie)	.....	11.28	1.73		74.97		12.02	1.92	.....	.....	13.78	9.13
22	Michigan	3.969	10.71	1.64	2.06	72.12	1.80	11.67	1.87	4.902	3.402	15.23	10.50
8	Kentucky	3.454	10.83	1.75	1.87	70.37	2.03	13.15	2.10	3.666	3.146	14.53	11 90
14	Tennessee	3.150	10.19	1.89	2.00	71.33	2.02	12.51	2.00	3.990	2.138	16.63	10.15
12	Missouri	3.502	9.80	1.92	2.19	72.36	2.17	11.56	1.86	3.867	3.098	14.00	10.50
9	Minnesota	3.354	10.60	1.71	2.03	70.96	2.04	12.66	2.03	3.828	3.116	17.15	10.85
10	Kansas	3.204	11.80	1.64	1.98	71.35	2.08	11.15	1.78	3.424	2.881	12.25	10.50
19	Texas	2.847	10.03	1.81	2.11	70.85	2.06	13.14	2.10	3.937	2.561	15.23	10.68
45	Colorado	4.682	9.57	2.21	2.38	70.91	1.62	13.31	2.13	5.924	3.851	15.94	11.19
8	Oregon	5.044	9.74	1.84	2.08	76.18	1.56	8.60	1.37	5.745	4.253	9.47	8.05

The question arises at once as to whether the average American wheat can compare with that produced in foreign countries. The analyses of foreign wheats have been collected and averaged by several continental investigators, and their results furnish us with a means for making the comparison.

AVERAGE COMPOSITION OF FOREIGN WHEATS.

Locality.	Authority.	No. of analyses.	Water.	Ash.
			Per cent.	*Per cent.*
Russian	Laskowsky	24	11.49	
German	Wolff		14.40	1.70
Continental	Peligot	14	14.00	1.60
Do	Millon	16	13.82	1.57
Do	Reiset	20	14.43	1.99
World	König	200	13.56	1.79
Do	Kühn		14.30	1.70

Locality.	Authority.	Oil.	Carbhydrates.	Fiber.
		Per cent.	*Per cent.*	*Per cent.*
Russian	Laskowsky	1.57		
German	Wolff	1.50	66.40	3.00
Continental	Peligot	1.20	66.90	1.70
Do	Millon	1.74	70.13	1.70
Do	Reiset		70.58	
World	König	1.70	67.87	2.66
Do	Kühn	1.60	66.20	3.00

Locality.	Authority.	Albuminoids.	Highest albuminoids.	Lowest albuminoids.
		Per cent.	*Per cent.*	*Per cent.*
Russian	Laskowsky	19.48	24.56	10.68
German	Wolff	13.00		
Continental	Peligot	14.60	21.50	10.60
Do	Millon	11.04	13.81	9.92
Do	Reiset	13.00	17.94	10.69
World	König	12.42	24.16	8.19
Do	Kühn	13.20	24.10	8.20

At a glance it is apparent that the main failing of our wheats is their deficiency in albuminoids. In other regards they seem to be a degree lighter per hundred grains; they contain less water and about the same ash, more oil and a smaller amount of fiber. The variation in some of the constituents is quite large and should be taken into consideration with the averages. In the 260 wheats which I have examined, the following are the highest and lowest determinations made:

Limits and variation in the percentages of the constituents of wheats, and in the weight of 100 grains.

Constituents.	Highest percentage.	Lowest percentage.	Variation.	Above average.	Below average.
Water	12.44	7.85	4.59	2.02	2.57
Ash	3.57	.80	2.77	1.82	.95
Oil	3.93	1.40	2.53	1.76	.77
Carbhydrates	78.66	64.84	13.82	6.68	7.14
Fiber	3.05	.44	2.61	1.25	1.36
Albuminoids	17.15	8.05	9.10	5.20	3.90
Weight of 100 grains ....grams..	5.924	1.830	4.094	2.286	1.808

The extremes here given are due in no case, with the exception, perhaps, of the lowest water, to errors in analysis. All the determinations on which the table is based have been repeated in duplicate and verified, and the figures, without doubt, exhibit about the extremes which one may expect to find in any equal number of wheats.

Ash, oil, and albuminoids have the most striking variations, and it will be observed that they never will fall as far below the average in amount as at times they rise above it. In proportion to their importance and amount, the extent of variation of the albuminoids forms the most remarkable feature of the wheat grain. In our wheats, however, it is not so great as has been found in those of other countries, as may be seen in the following table:

Maxima and minima of albuminoids, percentage of nitrogen, and weight of 100 grains of wheat.

No. of analyses.	Locality.	Authority.	Percent. of nitrogen.	Per cent. of Albuminoids.	Albuminoids.		Weight of 100 grains.		
					Maximum.	Minimum.	Average.	Maximum.	Minimum.
					Pr cent.	*Pr cent.*	*Grams.*	*Grams.*	*Grams.*
25	North German	Voo Bibra	2.20	13.76	18.25	9.80	4.270	7.450	3.200
20	South German	do	2.13	13.28	17.81	9.68	4.473	7.000	2.875
14	Scotch	do	2.07	12.95	14.63	11.06	4.679	5.200	3.850
5	Egypt	do	1.46	9.10	9.94	8.75			
2	Australian	do	1.60	9.98	9.98	9.94			
13	Algerian	do	2.20	13.75	15.50	11.25	5.540	6.525	4.600
9	Spanish	do	2.30	14.35	24.13	11.25	4.278	5.125	3.850
7	Russian	do	2.45	15.31	21.70	10.44	3.950	5.350	1.800
24	Do	Laskowsky	3.13	19.48	24.16	10.68			
	England	Lawes & Gilbert	2.20	13.76	15.50	11.25			
	Germany	Mayer	2.20	13.75					
	Do	Wolff	2.08	13.00					
15	Continental	Millon	1.88	11.75	12.63	9.88			
12	Do	Peligot	2.23	13.97	21.50	9.90			
20	Do	Reiset	2.04	12.78	17.90	10.68			
176	Average, excluding Russia	König	1.98	12.35	21.37	7.61			
	Average of world	Kühn	2.11	13.20	24.10	8.20			

While among our wheats the highest percentage of albuminoids was found to be 17.15 in a wheat from Minnesota, Russian grain has been analyzed by Laskowsky which contained 24.56 per cent., twenty-four different specimens averaging 19.48 per cent., the lowest having 10.68 per cent. of albuminoids. The range is by these analyses largely extended, and if the wheats of all countries are taken into consideration it rises to 19.23 per cent., and the great susceptibility of wheat in this direction is made manifest. As the albuminoids are regarded, and probably rightly, as the most valuable part of the grain when properly elaborated, the effect of environment on this constituent will be one of the most important considerations in the study of the American grain, after its comparison with the foreign article has been completed in regard to the less important constituents. It is difficult to say for what reason our wheats contain so much less water than is given in the foreign averages quoted. We have never seen a sample which contained as much even as the average of Wolff for German wheat, and are aware

of only one analysis made in this country, and that by Jordan of a Pennsylvania wheat grown by himself, which exceeded 13 per cent. At times it seemed that it might be due to a drying out of the small specimens which were furnished us, and again to method of preparation for analysis, but neither explanation has been found to be correct, and it must be considered as some inherent peculiarity of our wheats which is due perhaps to our hotter and drier summer weather. When we come to consider the wheats of the different sections of the country it will be seen that the variation due to locality is imperceptible, but this again may be owing to the manner of preservation and preparation of the samples in our laboratory.

In oil our averages are hardly comparable as the larger amount found may be due to more thorough methods of extraction than were employed in the older analyses of foreign investigators before the continuous percolation apparatus was brought into use.

In ash the averages are quite alike, but it will be seen that in some portions of the United States, on new and rich soil, this constituent is much increased.

The amount of fiber present in our wheats is decidedly smaller as was found in a previous investigation to be the case in a large number of grasses when compared with continental varieties. A decrease in the albuminoids seems to be often accompanied by a decrease in fiber. It was found to be so in oat straw and grain by Beseler and Maercker in an investigation of that plant which they have recently published. How large an effect the changes in the small amount of fiber present in the grain may have on its milling properties it is not possible to say, but it is not probable that it is directly proportional to the percentage.

The average weight of one hundred grains is considerably smaller in this country than abroad, but allowance must be made for the averages which I have collected for foreign countries, as they are comparatively few in number and perhaps from selected samples, while the averages for our own wheat include all sizes grown under all conditions. The importance of this determination cannot be too strongly insisted upon as the confusion which may arise from mere chemical analyses without some knowledge of the physical properties of the grain will be shown in some analyses given in a later portion of this paper.

As has been shown, our average American wheat does not equal the average foreign wheat in albuminoids, except those from Egypt and Australia, but the averages for these localities are derived from too few data to be depended on. In studying the wheats of this country, however, according to the different portions of it from which they come, it becomes apparent that the averages for these localities differ from the general average of the whole country in a marked degree. The averages which were described for the Atlantic and Gulf States, for the Middle West, and for the West, and for the Pacific Coast, show that in the East our wheat is the poorest in the land, falling below the gen-

eral average in albuminoids and ash, and in the size of the grain. A regular gradation of improvement from East to West, however, is found in examining the other averages, until the Pacific coast is reached, where there is a most remarkable falling off in everything but the size of the grain. It is in the country between the Mississippi and the mountains that the best grain is produced. It has a higher average ash and a larger average amount of oil and albuminoids than that of any other part of the country, and it will be noticed that the highest extremes for ash, oil, albuminoids, and for weight of 100 grains are also found in this region. The Middle West, represented by Michigan, Kentucky, and Tennessee, holds an intermediate position between this district and that on the Atlantic coast. The latter shows plainly that its soils have become more or less worn out, the Middle West that it is losing its fertility, and the far West the fact that it contains those stores of plant food, and nitrogen especially, which make a rich grain of wheat. Why nothing better has been done in the way of production than a percentage of albuminoids as high as 17.15 is difficult to say, but the conditions undoubtedly do not equal those to be found in Russia.

The regular increase in the size or rather weight of 100 grains from the Atlantic to the Pacific is undoubtedly due to the greater amount of plant food supplied as we go westward; but we are again surrounded with difficulties when, the weight remaining large, an attempt is made to explain the great falling off in nitrogen in the Pacific coast wheats. It merely makes more prominent the peculiar susceptibility of this grain to its surroundings, and the fact that the largest grain and crops can be produced where there is an inability to assimilate nitrogen or a lack of nitrogen to be assimilated. The wheats of California have not yet been examined, but from what it has been possible to learn we understand that they are as fair in appearance as those of Oregon, but of poor milling qualities, which would point to a low percentage of albuminoids.

In 1878 a number of spring wheats were analyzed at the Department, and it was found that they contained much more nitrogen than ordinary winter varieties grown under the same conditions, with the exception of the spring wheats from Oregon. There they had been unable, even as spring wheat, to assimilate an average amount of nitrogen. The analyses are quoted:

Locality.	Albuminoids in—	
	Winter wheat.	Spring wheat.
	Per cent.	*Per cent.*
Canada	9.45	.....
Canada	9.89	14.70
New York	.....	15.40
New York	.....	14.00
Ohio	11.59	.....
Oregon	8.40	8.14
Oregon	9.45	9.80

These figures, together with other analyses of Oregon wheats, seem to warrant the conclusion that it is a peculiarity of Oregon and proba-

bly California wheat to contain a comparatively low amount of albuminoids, although the grain is large and handsome.

The other States, considered individually, appear to vary very much as wheat producers, even in relation to their own sections; that is to say, no one of the sections of the country which I have selected produces wheats of similar composition in its several states. The Atlantic States are more nearly uniform in this respect. Virginia apparently produces the finest wheat, but it must be said in explanation that the eleven samples from this State were not of such a nature, as may be seen from their description, as to represent its average production. It is a fact, however, that the Maryland and Virginia wheats bring a somewhat higher price in the Baltimore markets than any from other sections of the country. The samples from North Carolina are the lowest in percentage of albuminoids, but they were all fine-looking grain, and of larger average size than any I have seen from the East. The variation in the averages is not large, nor does it furnish us with any evidence that latitude has any effect upon the composition of the grain. The middle portion of the section produces a slightly better wheat, in fact is more of a wheat-growing country, and with the rational method of cultivation and fertilization which are rapidly becoming known and put in practice it will undoubtedly improve its average.

The middle, west, or central portion of our country is represented by averages for Michigan, Kentucky, and Tennessee, among which Kentucky easily holds the supremacy, if the eight wheats from various parts of the State actually furnish an average to be depended on. The samples from both Kentucky and Tennessee were mostly collected by the Louisville and Nashville Railroad, and were no doubt as good as could be found; but since no wheat among twenty-two has fallen below 10 per cent. of albuminoids, the States may be regarded as producing a good grain for this country which in one State averages 13.15 and in the other 12.51 per cent. of albuminoids.

After crossing the Mississippi the averages show that in Missouri and Kansas wheats are deficient in nitrogen, while Texas produces a grain rich in nitrogen but injured by too small weight per hundred. Minnesota has a much larger grain, not quite as well supplied with nitrogen. It is Colorado which leads our country in the production of a large grain, containing a large amount of albuminoids. This State shows what the possibilities are of raising a perfect wheat, and the conditions which must be taken into consideration. Perhaps Texas, with the same care, would produce as fine a wheat, and the same may be said of Minnesota. The conditions, in addition to soil and climate, which have been observed in Colorado, and some of which are certainly too much neglected elsewhere, are careful selections of the seed as to quality, sources, and avoidance of contamination and reversion, careful cultivation, irrigation where necessary, and, most of all, close observation. These conditions have been strictly attended to in the case of the Colorado wheats. The same care would have undoubtedly improved the wheat in other locali-

ties. In Texas, for instance, the seed has probably been of poorer quality, the cultivation less careful, and the necessary water supply lacking.

The wheats from Colorado which have been analyzed were from the experimental farm of the Colorado Agricultural College, at Fort Collins, on the Caché la Poudre River, where the soil is alluvial, containing plenty of lime from the neighboring cretaceous shales. They were grown under the direction of Prof. A. E. Blount, who has done much in the past few years to improve the varieties of wheat which have come into his hands by careful selection, hybridization, and continuous cultivation on the rich soils of Colorado. Of his experiments and their results in 1881 he says, alluding to the wheats which were analyzed:

These hybrids (see analyses of Colorado wheats) are but two years old, and hence have not become fixed. I crossed them in order to make the offspring better in quality and quantity for both farmer and miller. The objects attained by crossing wheats, or hybridization, as it is improperly called, are manifold. It improves the plant in various ways. It makes it more vigorous, less liable to the attacks of vegetable parasites; the straw is stiffer, better glazed and more healthy, the leaves better feeders as well as the roots; the glumes are more compact and better filled; the heads longer, and fertilization takes place more surely and successfully. Secondly, it improves the grain; makes it more plump, heavier, harder; consequently better suited to milling purposes; the bran is made thinner, more free from fluff and cellulose, the two obstacles which interfere so materially with milling; the grain is entirely transformed, being made to contain more or less gluten, starch, and other elements that make good flour.

The whole operation is very similar to breeding stock. The experimenter must thoroughly understand the entire vegetable and physiological structure of both wheats before he can make a cross with improvement on either parent.

WHEATS FROM COLORADO.

	Blount's Hybrid, No. 10.	720. Blount's Hybrid, No. 15.	721. Blount's Hybrid, No. 16, select.	722. Blount's Hybrid, No. 17.	723. Blount's Hybrid, No. 18.	724. Blount's Hybrid, No. 19, select.	725. Blount's Hybrid, No. 20.	726. Seed from New South Wales.	727. Centennial.
Color	Amber	Red..	Red..	Red	.....	.....	.....	Yellow	.....
Hardness	Hard	.....	Soft..	Hard	.....	.....	.....	Hard	.....
Weight of 100 grains	.....	.....	4.824	5.137	.....	.....	.....	4.657	.....
Specific gravity	1.397	.....	1.331	1.308	.....	.....	.....	1.255	.....
Fresh gluten	42.22	32.24	52.92	34.16	32.22	36.96	35.22	28.31	23.80
Dry gluten	14.44	11.38	11.19	11.88	10.74	12.14	11.74	10.64	9.22
Total nitrogen	2.20	1.96	1.88	2.18	2.07	1.99	1.96	2.02	1.93
Moisture	9.72	10.07	9.53	9.93	9.74	10.45	10.57	9.47	9.66
Ash	2.28	1.93	2.04	2.07	2.19	2.54	3.57	2.18	2.35
Fat	2.16	2.68	2.54	3 93	1.58	2.19	2.32	2.40	2.00
Sugar, &c	4.12	2.92	3.38	4.20	3.32	3.44	3.64	4.22	3.06
Dextrine, &c	2.22	2.46	1.90	9.00	1.49	2.68	2.66	3.08	2.10
Starch, &c	61.10	66.12	67.24	53.66	67.23	64.47	63.32	64.68	67.67
Albuminoids, soluble in 80% alcohol	4.30	3.18	4.26	.80	3.57	3.28	3.71	5.05	4.26
Albuminoids, insoluble in 80% alcohol	9.60	9.06	7.49	12.82	9.37	9.10	8.54	7.57	7.80
Crude fiber	1.32	1.57	1.62	1.59	1.60	1.79	1.67	1.55	1.10
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total nitrogen × 6.25	13.75	12.25	11.75	13.62	12.94	12.44	12.25	12.62	12.06

WHEATS FROM COLORADO—Continued.

	728. El Dorado.	729. White Mexican.	730. Judkin.	731. Australian Club.	732. Fountain.	733. Perfection.	734. Russian.	735. Rio Grande.
Color	Yellow	Yellow	Red...	Amber	Yellow	Yellow	Red...	Red...
Hardness	Hard..	Soft...	.....	Hard..	Hard..	Hard..	Soft...	Soft...
Weight of 100 grains	4.702	.....	.....	5.506	5.100	5.536	4.131	5.906
Specific gravity	1.242	.....	.....	1.305	1.306	1.330	1.311	1.310
Fresh gluten	25.06	42.21	33.59	25.23	35.15	35.36	32.41	35.01
Dry gluten	9.49	14.33	12.10	8.91	11.93	12.07	12.13	12.34
Total nitrogen	1.88	2.21	1.96	1.79	2.18	2.27	2.32	2.35
Moisture	10.55	9.91	9.75	9.78	10.58	9.93	9.55	9.51
Ash	2.24	2.60	2.57	1.85	2.70	1.99	1.99	2.08
Fat	2.43	1.89	2.42	2.23	2.15	2.32	2.62	2.96
Sugar, &c	3.28	3.46	4.96	3.30	2.86	2.84	3.70	2.86
Dextrine, &c	1.82	2.20	2.80	1.92	2.32	1.80	2.20	2.58
Starch, &c	66.83	64.61	63.55	68.28	64.36	65.39	63.96	63.53
Albuminoids, soluble in 80% alcohol	3.83	4.20	1.97	3.01	3.53	4.34	3.81	3.19
Albuminoids, insoluble in 80% alcohol	7.92	9.61	10.28	8.18	10.29	9.84	10.68	11.50
Crude fiber	1.10	1.52	1.70	1.45	1.32	1.55	1.49	1.79
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total nitrogen × 6.25	11.75	13.81	12.25	11.19	13.62	14.18	14.49	14.69

	736. Touzelle.	737. German Fife.	738. Oregon Club.	739. Sonora.	740. Imperial Fife.	741. Lost Nation.	742. Pringle's No. 6.	743. Pringle's No. 7.
Color	Yellow	Red...	Yellow	Yellow	Yellow	Red...	Yellow	Med'm
Hardness	Med'm	Soft...	Soft...	Soft...	Hard..	Soft...	Med'm	Hard..
Weight of 100 grains	5.214	5.368	4.434	4.739	4.147	3.851	5.145	4.636
Specific gravity	1.301	1.283	1.326	1.344	1.325	1.323	1.304	1.347
Fresh gluten	33.25	38.33	28.92	34.86	39.47	29.52	34.78	33.69
Dry gluten	10.90	14.45	10.06	11.80	14.23	11.23	11.83	12.01
Total nitrogen	2.16	2.41	1.96	2.27	2.55	2.07	2.10	2.49
Moisture	10.23	10.42	9.59	10.17	9.43	10.24	9.89	9.89
Ash	2.10	2.31	1.91	2.02	2.64	2.17	2.13	2.23
Fat	2.35	2.79	2.19	2.13	2.31	2.99	2.52	2.20
Sugar, &c	3.24	2.02	3.10	3.18	4.04	3.52	3.52	2.94
Dextrine, &c	1.88	1.50	1.50	3.00	2.06	2.40	2.20	2.06
Starch, &c	65.05	63.42	67.86	63.92	61.95	64.01	65.85	63.68
Albuminoids, soluble in 80% alcohol	4.01	4.24	4.34	6.51	5.96	1.64	5.25	3.40
Albuminoids, insoluble in 80% alcohol	9.49	10.82	7.91	12.67	9.98	11.29	7.88	11.85
Crude fiber	1.65	1.48	1.60	1.40	1.63	1.74	1.70	1.78
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total nitrogen × 6.25	13.50	15.06	12.25	14.18	15.94	12.93	13.13	15.25

WHEATS FROM COLORADO—Continued.

	744. Clawson.	745. Hedge Row (winter crop).	746. Hedge Row (spr'g crop).	747. White Chaff.	748. Triticum.	749. Durum Russian.	750. Doty.	751. Meekins.
Color	Yellow	Yellow	Amber	Red...	Yellow	Med'm	Red...	Red...
Hardness	Soft...	Med'm	Hard..	Soft...	Hard..	Hard..	Soft...	Soft...
Weight of 100 grains	4.565	4.072	4.499	4.214	5.754	5.924	4.373	5.193
Specific gravity	1.289	1.357	1.338	1.233	1.315	1.326	1.284	1.293
Fresh gluten	26.91	34.01	30.14	32.44	34.32	37.54	35.81	38.61
Dry gluten	9.99	12.11	10.69	11.37	13.08	13.51	12.52	13.83
Total nitrogen	1.88	2.18	2.07	2.24	2.18	2.44	2.24	2.44
Moisture	10.14	9.07	9.17	9.57	10.02	9.91	9.41	9.38
Ash	1.94	2.08	2.59	2.13	2.67	2.32	2.35	2.53
Fat	2.31	2.11	2.09	2.44	2.65	2.00	2.50	2.97
Sugar, &c	4.10	2.80	3.12	4.80	4 60	4.28	3.68	5.12
Dextrine, &c	2.30	2.02	2.10	2.00	2.84	3.00	2.32	2.04
Starch, &c	65.86	66.68	66.66	62.88	62.09	61.30	63.94	61.17
Albuminoids, soluble in 80% alcohol	3.44	4.66	4.19	4.89	5.65	6.48	5.69	5.36
Albuminoids, insoluble in 80% alcohol.	8.31	8.96	8.75	9.11	7.97	8.77	8.31	9.89
Crude fiber	1.60	1.62	1.33	2.18	1.51	1.54	1.80	1.59
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total nitrogen × 6.25	11.75	13.62	12.94	14.00	13.62	15.25	14.00	15.15

An examination of the tables of analyses will show successes and failures in my work. A success cannot always be made in the first trial or the second. The experimenter is compelled to cross and recross sometimes in order to make a wheat that will suit both farmer and miller. Take Hybrid No. 18 for example. It is a failure so far as being fit for the mill is concerned. Why? Because the percentage of gluten, 10.74, is very much less than that of its mother. Improved Fife, 14.23, and but little, very little higher than that of its father, Australian Club, 8. 91. Had it been 11.57 or the average of both or more, there might have been a chance of making it a success. One more trial (the third) will settle the question whether or not it is worthy to be placed among the standards. How far it is a success or failure for the farmer remains to be determined.

Many wheats are splendid in the field and of no account in the mill and *vice versa*.

Please notice No. 19 in the table. The father wheat, Improved Fife, contains 14.23 per cent. of gluten; the mother, Oregon Club, 10.06 per cent.; average, 12.14 per cent.—exactly the per cent. that No. 19 contains. Now both these parent wheats were good for both farmer and miller, and I have reason to conclude that this offspring will be better than either parent when it is fixed. It is now only two years old, and will not become fixed or a standard until next year.

The above gives an idea of Professor Blount's method of working, and the analyses, which were made in more detail than usual, are represented to show his results. The parents of the different hybrids are given in the descriptions of the wheats under their serial numbers in the first part of this report. The first wheat, in all cases, is the father.

The effect upon the yield of the different varieties of a few years' growth upon Colorado soil is very marked.

For the samples of 1881 which were analyzed Professor Blount gives the following data:

Yield from one grain of different varieties of wheat introduced into Colorado.

Variety.	Fold first year.	Fold second year.	Fold third year.
Black Bearded Centennial			203
Judkin			320
Australian Club			416
White Fountain	440		
Russian	76	172	448
Touzelle	56	128	480
German Fife	112		
Oregon Club			480
Sonora	56	110	448
Improved Fife	56	126	416
Lost Nation	76	96	352
Clawson	68	136	544

All these wheats have been improved in this remarkable manner by selection, cultivation, and irrigation.

The average composition of the thirty-three varieties grown in 1881 is:

Weight of 100 grains	grams	4.865
Water	per cent	9.86
Ash	do	2.28
Oil	do	2.41
Carbhydrates	do	70.48
Crude fiber	do	1.57
Albuminoids	do	13.40
		100.00
Nitrogen		2.14

which is better than the averages for foreign grain, with the exception of Russia, but if the six wheats from that source are averaged by themselves they prove to be much superior to the remaining varieties.

Colorado wheats from Russian seed—1881.

Weight of 100 grains	grams	5.075
Water	per cent	9.69
Ash	do	2.41
Oil	do	2.44
Carbhydrates	do	69.49
Crude fiber	do	1.59
Albuminoids	do	14.54
		100.00
Nitrogen		2.32

and the same holds good when all the wheats whose seed had been obtained from foreign sources, except Australia, are averaged.

Colorado wheat from foreign seed—1881.

Weight of 100 grains	grams	5.187
Water	per cent	9.86
Ash	do	2.32
Oil	do	2.45
Carbhydrates	do	69.46
Crude fiber	do	1.57
Albuminoids	do	14.34
		100.00
Nitrogen		2.29

The remaining wheats from American seed, or seed which was not received direct from foreign sources or which came from Australia, give a correspondingly low average, showing that the tendency of foreign seed was to produce a better grain than domestic seed.

Average of Colorado wheat from domestic seed.—1881.

Weight of 100 grains	grams	4.714
Water	per cent	9.85
Ash	do	2.27
Oil	do	2.38
Carbhydrates	do	70.87
Crude fiber	do	1.58
Albuminoids	do	13.05
		100.00
Nitrogen		2.09

The superiority of the crops from foreign seed is marked.

The analyses which have just been discussed were of wheats of the harvest in 1881. In the autumn of that year thirteen selected seed wheats were sent to Professor Blount by the Department, and after harvest a portion of the seed furnished, and of the crop, was returned for inspection and analysis. To the eye alone they had all improved in appearance, and as a whole their average composition was very close to the average of the domestic varieties grown in 1881, as is seen by comparison.

Average composition of wheats from American seed, Colorado, 1881 *and* 1882.

		1881.	1882.
Number of analysis		24	12
Weight of 100 grains	grams	4.714	4.682
Water	per cent	9.85	8.80
Ash	do	2.27	1.99
Oil	do	2.39	2.38
Carbhydrates	do	70.87	72.08
Crude fiber	do	1.58	1.76
Albuminoids	do	13.04	13.04
		100.00	100.00
Nitrogen		2.09	2.09

The albuminoids are exactly the same both years, showing that the seasons which were somewhat different had not had a marked effect in this direction.

The changes which took place during one year's growth on Colorado soil of these seed is shown on a table which has been prepared with all the analyses calculated to a common basis of 10 per cent. of water.

COMPARISON OF DEPARTMENT SEED AND COLORADO CROP.

Variety.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Weight of 100 grains.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Grams.*
McGehee's Red:							
Department	10.00	1.04	2.46	71.57	1.46	13.47	2.811
Colorado	10.00	1.80	1.92	70.85	1.76	13.67	4.159
Finlay:							
Department	10.00	1.59	2.37	73.22	1.17	11.65	3.285
Colorado	10.00	1.83	2.34	71.60	1.72	12.51	4.125
Champ. Amber:							
Department	10.00	1.88	2.19	73.70	1.33	10.90	3.278
Colorado	10.00	2.16	2.42	72.24	1.52	11.66	4.347
Dallas:							
Department	10.00	2.10	2.43	71.54	1.61	12.32	4.023
Colorado	10.00	1.85	2.46	69.34	1.73	14.52	4.610
Bennett:							
Department	10.00	2.01	2.17	70.77	1.35	13.70	3.218
Colorado	10.00	2.15	2.52	70.00	2.00	13.33	3.976
Lemon:							
Department	10.00	1.87	2.46	68.87	1.50	15.30	3.417
Colorado	10.00	2.02	2.10	72.01	1.65	12.22	4.335
Gold Medal:							
Department	10.00	1.77	2.33	74.89	1.36	9.65	3.076
Colorado	10.00	1.78	2.24	72.11	1.72	12.15	4.374
German Amber:							
Department	10.00	1.66	2.57	74.01	1.02	10.74	2.938
Colorado	10.00	1.77	2.39	71.84	1.73	12.27	4.027
Rice:							
Department	10.00	2.11	2.28	69.73	1.60	14.28	3.586
Colorado	10.00	2.06	2.35	69.70	1.94	13.95	4.103
Washington Glass:							
Department	10.00	2.02	2.19	72.20	1.81	11.88	3.741
Colorado	10.00	1.92	2.37	73.16	1.16	11.39	4.450
Swamp:							
Department	10.00	2.04	2.01	68.05	1.79	16.11	3.660
Colorado	10.00	2.05	2.30	68.89	1.85	14.91	4.423
Wysor:							
Department	10.00	1.54	2.14	72.11	1.72	12.49	3.796
Colorado	10.00	2.22	2.16	71.13	2.09	12.40	4.609
Average Seed:							
Department	10.00	1.80	2.30	71.72	1.47	12.75	3.402
Colorado	10.00	1.97	2.30	71.07	1.74	12.92	4.299
Gain for crop	.....	9	7	9	11	6	12
Loss	.....	3	5	3	1	6	0

The average composition of the seed is, to begin with, remarkably good, showing, that they were of fine quality, or at least a majority of them. The average for the crop shows a slight gain over the seed in ash, no change in oil, a slight loss in starch, and slight gain in fiber and albuminoids. The first question that arises is: Why have the albuminoids failed to improve more? This is explained by a study of the analyses separately. It has been shown that the average amount of albuminoids found in Professor Blount's wheats of 1881 from domestic sources was 13.04, and in the analyses of the 1882 crops it will be seen that those which were from seed containing high amounts of albuminoids fell toward the average figure, while those low in albuminoids had a tendency to rise toward it; that is to say, six increased and six decreased

their albuminoids, the average agreeing with that of 1881, which seems to point to the fact the Colorado soil has a capacity for supporting a percentage of albuminoids in a wheat of about thirteen, and that if a variety in the seed has more than this it will tend to decrease to that figure, and *vice versa*. For example: A wheat having 16.11 per cent. in the grain sown, contained only 14.91 per cent. in the grain harvested, and one having 9.65 in the seed increased to 12.15 per cent., but of course a fall happens much more readily than the reverse. The Washington Glass having only 11.88 per cent. of albuminoids in the seed failed to improve, but this is owing to an inherent dislike of this wheat wherever it grows to assimilate nitrogen, a peculiarity which Colorado could not overcome.

In the other constituents the ash increased in nine cases out of twelve, the new soil furnishing a large supply of mineral food, the oil in seven, and the fiber in eleven cases. The increase of the latter seems to be a common accompaniment of flourishing growth. In every case the size and general appearance was much improved, and, as a consequence, the weight of one hundred grains of the crop was much heavier than of the seed—in fact, averaged over twenty-six per cent. heavier.

Of the forty-four wheats from Colorado grown during two years, only one fell below 11½ per cent. of albuminoids, and only six below 12 per cent. Only two of this number weighed less than 4 grams per hundred grains. In North Carolina, on the contrary, twenty-two of whose wheats were analyzed, only two exceeded 12 per cent. of albuminoids, while the weight of one hundred grains averaged as high as 3.776. In Oregon another phase is presented, as has been before mentioned. Out of eight wheats which were analyzed by us, none contained more than 9.47 per cent. of albuminoids, or weighed less than 4.253 grams per hundred grains. In Virginia a stinted wheat was found, weighing only 1.830 per hundred grains, and yet having 14 per cent. of albuminoids. The effect of locality is well represented by these few facts, and the necessity for a determination of the weight of one hundred grains is apparent when a few of these exceptional analyses are printed side by side. From the chemical analyses alone we should be misled as to the value of the wheats which follow:

Analyses of wheats from different States.

	Oregon.	Colorado.	North Carolina.	Virginia.
Weight of 100 grains	5.745	5.193	4.628	1.830
Water	10.68	9.38	9.30	9.45
Ash	2.20	2.53	1.80	2.45
Oil	2.16	2.97	2.25	2.18
Carbhydrates	74.91	68.38	75.42	70.02
Fiber	1.65	1.59	1.95	1.90
Albuminoids	8.40	15.15	9.28	14.00
	100.00	100.00	100.00	100.00
Nitrogen	1.34	2.43	1.43	2.24

Too much confidence, it is seen, cannot be placed on the size and appearance of a wheat, or, conversely, on the chemical analysis alone. When both these elements in its constitution are favorable, then alone can it be pronounced a good wheat.

The effects upon the composition of the grain which we have studied seem to be largely dependent on the soil, seed and cultivation being the same. A good illustration of this is furnished by some analyses which were lately made of seed which was sown in 1882 on both corn ground and fallow land on a farm in Maryland belonging to Judge John M. Robinson, and of the crops from the two fields.

Fultz wheat, Queen Anne County, Maryland.

	Seed wheat, 1882.	Corn ground, 1883.	Fallow, 1883.
Weight of 100 grains	3.198	3.685	3.602
Water	11.06	11.34	11.38
Ash	1.85	1.66	1.64
Oil	1.98	2.30	1.55
Carbhydrates	73.43	73.18	72.99
Fiber	1.70	1.72	1.59
Albuminoids	9.98	9.80	10.85
	100.00	100.00	100.00
Nitrogen	1.60	1.57	1.74

The better wheat season of 1883 produced a heavier grain than 1882, but as the soil was unchanged in itself or by unusual applications of fertilizers, the albuminoids increased only slightly on the fallow field. The latter, as one would expect, produces a grain richer in nitrogen than the corn ground, from its accumulated store of nitrogen. The fallow crop, too, was larger in amount than that from the corn ground.

Further information as to the effect of soils upon wheat has been sought by analyzing the seed distributed by the Department in the last two or three years, and as many samples of the crops raised therefrom as could be obtained. The results have already been given for Colorado and proved of great interest. In no other State has there been such an extended interest taken in the subject, and the specimens are therefore more scattered. The results which have been worked out appear in the table.

No.	Name.	Locality.	Date.	Spring or winter.	Color.	Consistency.	Weight of 100 grains.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.
							Grams.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
784	Red Mediterranean	Department seed, first lot	1882	Winter	Red	Hard	3.601	9.83	1.70	2.21	73.73	1.68	10.85	1.74
1817	Red Mediterranean	Lee County, Alabama	1883	Winter	Red	Hard	4.077	9.68	2.01	2.22	72.29	1.55	12.25	1.96
1818	do	Fayette County, Alabama	1883	do	do	do	3.535	10.98	2.18	1.89	69.52	1.95	13.48	2.16
1820	do	Lawrence County, Alabama	1883	do	do	do	4.473	10.54	1.95	2.04	71.95	1.62	11.90	1.90
1819	do	Rusk County, Texas	1883	do	do	do	3.525	8.88	2.02	2.34	69.44	2.09	15.23	2.44
1826	do	Parker County, Texas	1883	do	do	do	3.320	11.61	1.69	2.08	70.62	1.92	12.08	1.93
1839	do	Bibb County, Georgia	1883	do	do	do	2.894	9.19	2.04	2.13	72.18	2.03	12.43	1.99
1823	do	Baker County, Georgia	1883	do	do	do	2.834	12.20	1.66	2.09	69.57	1.88	12.60	2.02
	Average						3.522	10.44	1.94	2.11	70.79	1.86	12.85	2.05
779	White Mediterranean	Imported	1882	Winter	White	Soft	4.710	10.55	1.60	2.11	72.41	2.00	10.33	1.65
1824	White Mediterranean	Bedford County, Tennessee	1883	Winter	Yellow	Soft	2.469	10.92	2.38	1.90	66.71	2.86	15.23	2.44
1825	do	Clay County, Texas	1883	do	White	do	3.700	12.05	2.02	1.59	68.95	1.91	13.48	2.16
1829	do	Colbert County, Alabama	1883	do	do	do	3.612	10.15	1.96	1.62	73.76	1.83	10.68	1.71
1834	do	Worcester County, Maryland	1883	do	do	do	3.472	11.92	1.63	1.77	70.30	2.30	12.08	1.93
1843	do	Tipton County, Tennessee	1883	do	Yellow	do	2.138	10.64	2.10	2.04	72.87	2.20	10.15	1.62
	Average						3.074	11.13	2.02	1.78	72.52	2.22	12.33	1.97
801	Rice, 1881	Department seed, Maryland	1881	Winter	Red	Hard	3.586	8.40	2.15	2.32	70.97	1.63	14.53	2.39
1836	Rice	Cape Girardeau County, Missouri	1883	Winter	Dark red	Hard		9.36	1.88	2.37	70.62	1.77	14.00	2.24
1837	do	Clinton County, Kentucky	1882	do	Red	do	3.465	10.53	1.79	1.99	69.55	1.61	14.53	2.32
1838	do	do	1883	do	do	do	3.645	10.96	1.52	1.94	69.89	1.69	14.00	2.24
	Average						3.555	10.28	1.73	2.10	70.02	1.69	14.18	2.27
869	Rice, 1882	Department seed, Maryland	1882	Winter	Red	Hard	3.095	10.00	1.80	2.18	71.89	1.88	12.25	1.96
1807	Rice	Lee County, Alabama	1883	Winter	Dark red	Hard	3.731	10.78	2.02	2.42	71.67	1.56	11.55	1.85
1840	do	Loudon County, Tennessee	1883	do	Red	do	3.734	9.19	2.04	2.15	74.40	2.24	9.98	1.60
	Average						3.733	9.99	2.03	2.29	73.03	1.90	10.76	1.73

ANALYSES OF WHEATS, 1882–'83, FROM DEPARTMENT SEED—Continued.

No.	Name.	Locality.	Date.	Spring or winter.	Color.	Consistency.	Weight of 100 grains.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.
							Grams.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
775	Tennessee amber	Department seed, Tennessee	1882	Winter	Amber	Hard	3.204	9.90	1.85	2.09	72.78	1.48	11.90	1.90
1809	Tennessee amber	Lee County, Alabama	1883	Winter	Amber	Lt	3,486	10.84	1.96	2.07	72.57	1.53	11.03	1.76
1835	do	Cape Girardeau County, Missouri	1883	do	do	Med		9.41	1.88	2.35	74.01	1.85	10.50	1.68
	Average						3,486	10.13	1.92	2.21	73.29	1.69	10.76	1.72
776	Osterey	Department seed, Missouri	1882	Winter	Yellow	Hard	3,340	10.24	1.80	2.31	72.37	1.73	11.55	1.85
1830	Osterey	Hancock County, Indiana	1883	Winter	Yellow	Hard	2,768	10.16	2.05	1.51	73.41	2.02	10.85	1.74

Two seed wheats from foreign sources, the Red and White Mediterranean, have been widely distributed, and several of the resulting crops returned for analysis. Of the other foreign varieties sent out by the Department, no samples have been returned. The analyses of all the imported seed which have been distributed are nine in number, and are here given.

ANALYSES OF FOREIGN WHEATS INTRODUCED INTO AMERICA AS SEED.

No.	Name.	Locality.	Year.	Spring or winter.	Color.	Consistency.	Weight of 100 grains.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.
							Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
.....	Molds White	England	1878	Winter	White	Soft	.....	8.64	1.64	2.32	76.14	1.63	9.63	1.54
.....	Molds Red	do	1878	do	Red	Hard	.....	8.75	1.72	2.05	75.71	1.27	10.50	1.68
752	Russian Spring	Russia	1882	Spring	do	Soft	3.458	11.01	1.98	2.53	70.34	1.70	12.44	1.99
753	French Imperial	France	1882	do	do	do	.....	10.39	2.53	3.05	70.13	2.02	11.88	1.90
784	Red Mediterranean	Europe, first lot	1882	Winter	do	Hard	3.601	9.83	1.70	2.21	73.73	1.68	10.85	1.74
1828	Red Mediterranean	Europe, second lot	1882	do	do	do	3.500	9.88	1.62	2.05	73.80	1.79	10.85	1.74
779	White Mediterranean	Europe	1882	do	White	Soft	4.710	10.55	1.60	2.11	72.41	2.00	10.33	1.65
776	Osterey	Imported	1882	do	Red	Hard	3.340	10.24	1.80	2.31	72.37	1.73	11.55	1.85
1841	Black Sea	do	1883	do	do	do	2.532	9.78	1.74	2.06	68.48	1.87	16.10	2.58
	Average						3.523	9.90	1.93	2.30	72.56	1.74	11.57	1.85

With the exception of the small sized Black Sea wheat sent out in the autumn of 1883, they do not sustain the reputation of foreign wheats derived from the analyses which have been quoted. The results of the analyses of the crops of the Red and White Mediterranean show that although poor in themselves, the foreign wheats had a tendency to, and in almost every case did, increase their percentage of albumen wherever they were grown. They often diminished in size, however. The crops from domestic seed, on the contrary, never improved even under circumstances where the foreign seed did so.

The irregularity of the way in which the specimens were grown makes any conclusions based upon their analyses unsafe, and the results are merely recorded until they can be added to and completed. It may be said, however, that the two lots of rice wheat, distributed in 1881 and in 1882, differed in a marked degree in the amount of albuminoids they contained, and the crops from them differed in quite as marked a manner, being easily identified as from one source or the other by the albuminoids which they contained. Such a permanent difference would scarcely last any length of time if the soil were unable in any case to sustain the higher albuminoids of the 1881 seed. In Kentucky, in two cases, the high percentage was found in two successive crops, but fell off a per cent. in the second year more, and there seems to be no reason from the analyses which we have made to characterize a variety of any one name as containing under all circumstances a higher percentage of nitrogen than another.

ANALYSES IN GREATER DETAIL.

In the description of the methods of analyses an account was given of a more elaborate proximate examination than we have usually employed, and which was followed in the analyses of the Colorado wheats of 1881. Those analyses have been already printed in this form, and it merely remains to refer to certain others in the annual report of the Department for 1878 and to record in a like manner several made lately, which in the large tables by States are only given in their abbreviated form.

Detailed analyses of wheat.

	752. Russian Spring.	753. French Imperial.	754. Shumaker.	755. Clawson.	756. Fultz.	757. Shumaker.
Color	Red.	Red.			Red.	Red.
Consistency	Soft.	Soft.	Med. h'rd	Soft.	Med. h'rd	Med. h'rd
Weight of 100 grains	3.458	.....	4.377	3.856	3.454	3.349
Specific gravity	1.327	1.303	1.363	1.313	1.353	1.384
Fresh gluten	29.12	26.12	19.76	26.57	23.45	29.83
Dry gluten	10.54	9.26	7.65	9.07	7.80	9.91
Total nitrogen	1.99	1.90	1.46	1.71	1.68	1.99
Moisture	11.01	10.39	10.05	11.22	10.28	8.64
Ash	1.98	2.53	2.08	1.97	1.80	1.99
Fat	2.53	3.05	2.45	2.18	2.28	2.33
Sugar, &c	4.04	4.24	3.70	3.12	3.46	3.60
Dextrine, &c	2.40	2.34	1.74	2.00	1.60	1.68
Starch	63.90	63.55	68.57	66.47	67.80	66.83
Alb. sol. in 80 per cent. alcohol	4.19	4.44	4.53	5.66	3.43	4.15
Alb. insol. in 80 per cent. alcohol	8.25	7.44	4 60	5.03	7.07	8.29
Crude fiber	1.70	2.02	2.28	2.35	2.28	2.49
	100.00	100.00	100.00	100.00	100.00	100.00
Total N. × 6.25	12.44	11.88	9.13	10.69	10.50	12.44

	758. Zimmerman.	759. Clawson.	760. Russian No. 2.	761. Smooth Mediterranean.	762. Silver chaff.	763. Cross $\frac{D}{C}$ '78.
Color	Red.	Yellow.	Yellow.	Amber.	Amber.	Glassy.
Consistency	Med. h'rd	Hard.	Hard.	Med. h'rd	Hard.	Hard.
Weight of 100 grains	3.867	3.860	3.475	3.583	3.492	4.073
Specific gravity	1.373	1.364	1.384	1.352	1.364	1.413
Fresh gluten	28.49	25.24	28.29	29.58	28.97	26.37
Dry gluten	9.79	9.16	9.79	9.97	10.03	9.27
Total nitrogen	1.82	1.79	1.76	1.88	1.79	1.71
Moisture	9.18	9.18	8.43	9.45	10.99	10.87
Ash	2.01	1.91	2.09	1.89	2.22	1.75
Fat	2.35	2.16	2.23	1.80	2.42	2.04
Sugar, &c	3.36	3.70	3.14	3.12	3.40	3.18
Dextrine, &c	1.54	1.68	1.56	1.86	1.76	2.00
Starch	67.61	67.90	68.83	67.45	65.73	66.95
Alb. sol. in 80 per cent. alcohol	3.64	5.17	4.92	5.30	4.58	3.97
Alb. insol. in 80 per cent. alcohol	7.74	6.02	6.08	6.45	6.61	6.72
Crude fiber	2.57	2.28	2.72	2.68	2.29	2.52
	100.00	100.00	100.00	100.00	100.00	100.00
Total N. × 6.25	11.38	11.19	11.00	11.75	11.19	10.69

[Locality, &c.: Nos. 752, 753, spring wheat distributed by Department. Nos. 754, 755, W. J. Beall, Lansing, Mich. Nos. 756–762, Missouri Agricultural College. No. 763, Hosford, Vt.]

At present no attempt at interpretation of these data seems desirable.

GLUTEN.

In a large number of the wheats which have been analyzed, determinations of gluten have been made mechanically. The results are here tabulated:

Serial number.	Per cent. of total nitrogen.	Per cent. of albuminoids.	Per cent. of moist gluten.	Per cent. of dry gluten.	Ratio of dry to moist gluten.	Factor for nitrogen to dry gluten.
731	1.79	11.20	25.23	8.91	35.3	4.97
744	1.88	11.73	26.91	9.99	37.1	5.31
721	1.88	11.73	32.92	11.19	34.0	6.48
728	1.88	11.73	25.06	9.49	37.8	5.05
727	1.93	12.08	23.80	9.22	38.7	4.77
720	1.96	12.25	32.24	11.38	35.3	5.81
725	1.96	12.25	35.22	11.74	33.3	6.00
730	1.96	12.25	33.50	12.10	36.0	6.17
738	1.96	12.25	28.92	10.06	34.8	5.13
724	1.99	12.43	36.96	12.14	32.8	6.10
726	2.02	12.60	28.31	10.64	37.6	5.26
723	2.07	12.95	32.22	10.74	33.3	5.19
741	2.07	12.95	29.52	11.23	38.0	5.41
746	2.07	12.95	30.14	10.69	35.5	5.16
742	2.16	13.48	34.78	11.83	34.0	5.63
736	2.16	13.48	33.05	10.90	33.9	5.04
722	2.18	13.65	34.16	11.88	34.8	5.45
732	2.18	13.65	35.15	11.93	33.9	5.47
745	2.18	13.65	34.01	12.11	35.6	5.55
748	2.18	13.65	34.32	13.08	38.1	6.00
729	2.21	13.83	42.12	14.33	34.0	6.49
747	2.24	14.00	32.24	11.37	35.3	5.08
750	2.24	14.00	35.81	12.52	34.9	5.58
733	2.27	14.18	35.36	12.07	34.1	5.31
739	2.27	14.18	34.86	11.83	33.9	5.19
734	2.32	14.53	32.41	12.13	37.4	5.23
735	2.35	14.70	35.01	12.34	35.2	5.25
737	2.42	15.05	38.33	14.45	37.7	6.00
743	2.44	15.23	33.69	12.06	35.8	4.94
749	2.44	15.23	37.54	13.51	35.9	5.54
751	2.44	15.23	36.61	13.83	37.8	5.66
740	2.55	15.93	39.47	14.23	36.0	5.58
Average.	2.14	13.38	33.12	11.74	35.5	5.49

Wheats from Colorado, 1882.					Seed from Department, 1881.				
Serial number.	Per cent. of nitrogen.	Per cent. of albuminoids.	Per cent. of moist gluten.	Per cent. of dry gluten.	Serial number.	Per cent. of nitrogen.	Per cent. of albuminoids.	Per cent. of moist gluten.	Per cent. of dry gluten.
786	.....	.....	.....	.....	785	2.18	13.65	37.05	14.50
788	2.02	12.60	32.74	12.37	787	1.88	11.72	24.24	10.15
790	1.90	11.90	28.62	11.57	789	1.76	11.03	24.29	9.27
792	2.32	14.53	33.61	13.16	791	2.02	12.60	23.48	9.16
794	2.18	13.65	36.42	13.19	793	2.24	14.00	34.35	13.27
796	1.99	12.43	33.58	12.35	795	2.49	15.58	46.17	17.19
798	1.96	12.25	32.55	11.86	797	1.57	9.80	9.67	3.82
800	1.99	12.43	37.79	.....	799	1.76	11.03	19.88	8.08
802	2.27	14.18	45.26	15.54	801	2.32	14.53	38.66	13.99
804	1.85	11.55	26.29	10.16	803	1.93	12.08	25.84	9.78
806	2.38	14.88	40.95	15.06	805	2.66	16.63	47.57	17.83
808	2.02	12.60	36.90	13.18	807	2.02	12.60	36.35	12.83
Average.	2.09	13.06	34.69	12.89	Average.	2.07	12.94	30.63	11.66
Highest	2.38	14.88	45.26	15.54	Highest	2.66	16.63	47.57	17.83
Lowest	1.85	11.55	26.29	10.16	Lowest	1.57	11.03	9.67	3.82

Wheats from North Carolina, 1882.

Serial number.	Per cent. of nitrogen.	Per cent. of albuminoids.	Per cent. of moist gluten.	Per cent. of dry gluten.	Serial number.	Per cent. of nitrogen.	Per cent. of albuminoids.	Per cent. of moist gluten.	Per cent. of dry gluten.
811	1.76	11.03	27.68	10.56	824	1.62	10.15	23.98	9.18
812	1.43	8.93	12.78	5.16	825	1.90	11.90	30.55	11.55
813	1.65	10.33	17.47	6.99	826	1.48	9.28	17.62	7.12
814	1.62	11.15	23.01	9.02	827	1.54	9.63	18.31	7.18
815	1.60	9.98	24.45	9.25	828	1.82	11.38	27.32	10.63
816	1.54	9.63	17.77	6.92	829	1.96	12.25	32.49	12.05
817	1.51	9.45	25.23	9.55	830	1.99	12.43	32.39	12.38
818	1.60	9.88	22.14	8.46	831	1.60	9.98	22.18	8.74
819	1.79	11.20	30.43	11.30					
820	1.46	9.10	18.81	7.73	Average.	1.67	10.50	23.94	9.26
822	1.71	10.68	23.00	9.54					
823	1.88	11.73	31.24	11.97	Highest.	1.99	12.43	32.49	12.38
					Lowest..	1.43	8.93	12.78	5.16

Wheat from Oregon.					Wheat from Virginia.				
Serial number.	Per cent. of nitrogen.	Per cent. of albuminoids.	Per cent. of moist gluten.	Per cent. of dry gluten.	Serial number.	Per cent. of nitrogen.	Per cent. of albuminoids.	Per cent. of moist gluten.	Per cent. of dry gluten.
772	1.37	8.58	3.11	1.24	780	2.24	14.00	37.41	14.01
773	1.29	8.05	16.89	6.34	781	1.62	10.15	11.37	4.39
774	1.34	8.40	5.04	2.04	782	1.85	11.55	26.39	11.66

Relation of gluten to nitrogen, and of dry to moist gluten.

	Dry gluten to nitrogen.	Dry to moist gluten.
In Colorado wheat, 1881	5.49	35.55
In Colorado wheat, 1882	6.12	34.56
In seed sent to Colorado, 1881	5.63	38.07
In North Carolina wheat	5.54	38.68
In Oregon wheat	2.41	38.20
In Virginia wheat	5.22	39.98

The average gluten in the Colorado wheats of 1882 has improved over that in the seed furnished by the Department, although the average nitrogen is alike in both. This may, however, be due to the fact that many wheats after they have been preserved a year do not yield as much gluten as when they are fresh. This has been noticed in examination of the wheats grown in 1879, which we have had in hand this year, and for that reason determinations of gluten in these specimens have been omitted. As an example of the effect of time upon the gluten I have recently had some duplicate determinations made with wheats which had already been examined a year ago.

Duplicate determinations of gluten in wheat grown in 1882.

No.	Determinations made in 1882.		Determinations made in 1883.	
	Per cent of moist gluten.	Per cent. of dry gluten.	Per cent. of moist gluten.	Per cent. of dry gluten.
752	29.12	10.54	23.39	9.51
753	26.12	9.26	22.61	9.19
754	19.76	7.05	.00	.00
756	23.45	7.80	10.70	4.17

The later determinations are seen to be the lowest, but there is much difference in the way varieties act. No. 753, for instance, loses but slightly, while it was found to be impossible by the most careful manipulation to extract any gluten from No. 754 after it had stood a year.

An explanation is thus furnished of the fact that No. 797 of the seed wheats sent to Colorado has such an extremely low percentage of gluten. It had been preserved more than a year before the gluten was determined, and was a wheat which could not resist the action of time. Examinations of wheats at intervals in this way will distinguish their keeping qualities, a matter of great importance. Among the flours analyzed and described elsewhere is one which, from its low percentage of gluten and abnormal relation to its nitrogen content, is shown to be without any ability to withstand the effects of storage for a long time. It may safely be said that if a wheat or flour is found whose gluten falls below four times its nitrogen it has been injured by storage or some other injurious action; and from our averages it is apparent that a good wheat should contain as much as five and a half times as much gluten as nitrogen.

The North Carolina wheats contain the same relative amounts of nitrogen, and of moist and dry gluten as those from Colorado, and are in no way abnormal, but they show how low the gluten descends in our poorer Eastern wheats.

In the samples from Oregon and Virginia, on the contrary, the relations are very irregular. Those from Oregon are all extremely low, and only one within the limit of the necessary relation to the nitrogen. These wheats may have become injured, but it is more probable that it is an inherent peculiarity of the Oregon grain, for, as has been previously shown, the wheat from that State, at least as far as it has been examined, is quite different from any other wheat with which we are acquainted.

The specimens from Virginia are peculiar in that No. 780, the smallest wheat yet examined, weighing only 1.803 per 100 grains, is quite normal in its gluten content, while No. 781, grown under slightly more advantageous conditions directly beside it, is quite as abnormal.

Something in the method of harvesting or preservation of the sample must be the cause of this, but the determinations would be sufficient to show that No. 780, small as it is, would be preferable for bread-making to No. 781.

The crude gluten, after it has been extracted from the wheat, consists, as is well known, of the four principal nitrogenous constituents of the wheat, the fifth, albumen or cerealin, being washed away, and in addition there are present numerous impurities, including in the dry substance a small portion of water, which can only be removed at a high temperature, some fat, starch, and fiber. To determine the relative amount of these substances the following analysis of an average sample of crude gluten has been made.

Composition of crude gluten dried at 100° *C.*

Water	3.97
Ash	2.90
Fat	4.97
Fiber	3.24
N. × 6.25	74.19
Undetermined non-nitrogenous	10.73
	100.00

Only about 74 per cent. of the crude gluten is pure, and the remainder impurities; that is to say, if the pure gluten is supposed to contain 16 per cent. of nitrogen. As there were 10.73 per cent. of the crude substance which was neither water, ash, fat, nor fiber, and it seemed improbable that this could all be starch, the question arose as to whether the pure gluten did not contain less than 16 per cent. of nitrogen. Ritthausen had suspected from his work that variations in the amount of nitrogen in the constituents of gluten was possible, and in order to decide this point a small amount of pure substance was made from flour and analyzed with the following result: Ash-free gluten, dried at 130° C., contained 15.94 per cent. of nitrogen. 6.25 then is, without doubt, the proper factor to employ, and the undetermined 10.73 per cent. must consist of impurities. This amount is larger than that found by Ritthausen, but it seems to remain constant in all cases with the same method of manipulation, as is shown by the small variation in the relation of the crude gluten to the nitrogen, and therefore does not affect the results as a means of comparison of wheats, and judging of their milling qualities. It must merely be borne in mind that we are dealing with a crude, not a pure, gluten.

The relation between nitrogen and gluten in wheats which we have found agrees very well with Ritthausen's figures, but the amount is lower, as we might expect from the inferior amount of nitrogen in our wheats. He found that the dry gluten averaged 14.38 per cent, or 5.64 times the nitrogen, and his analyses show that the crude gluten which he obtained was rather purer than ours.

FLOUR AND BREAD.

The subject of flours and the bread produced from them has been very extensively considered on the continent of Europe and nowhere has

there been more attention given to it than in Hungary and in Vienna. In the reports of the United States Commissioners to the Vienna Exhibition of 1873, Professor E. W. Horsford has given an extensive paper upon the subject.

In considering the immediate causes of heavy and light bread, he shows that the gluten of the flour is the body whose tenacity and elasticity when in the dough enables it to hold the bubbles of gas which are formed in the process of rising, and that, consequently, a flour deficient in gluten cannot make a light bread. The gluten, however, when present in sufficient amount, must be in such a physical condition as not to be injured and discolored by the fermentation which goes on in the dough through the action of the yeast. The methods of milling are, of course, responsible for the condition in which the gluten is left in the flour originally, but the length of time and manner in which the flour is preserved have their ultimate effect upon it.

With a view to a study of the quality of some of our American flours in common use and the breads and other products made from them, the following analyses have been made:

986–992. Breads, rolls, buns, and cakes from J. Seitz bakery, Washington, D. C., purchased immediately after coming from the oven.

1135–1140. Flours used in making the previous breads, &c., and designated as follows:

1135. "Eagle Bluff." Illinois spring wheat.

1136. "Red River." Minnesota spring wheat.

1137. "Wife's Delight." Wisconsin spring wheat.

1138. "Richmond." Virginia winter wheat.

1139. "E. A. Schriver." Maryland winter wheat.

1140. "Red S." Ohio winter wheat.

1121–1122. Flour and bread made from it in the family of John Dugan. Received thirty-six hours after coming from the oven.

1177–1180. Flour and bran, and white and Graham bread made therefrom. Purchased at Kraft's bakery, Washington, D. C.

1181–2, 1194–1196. Flours, bread, and biscuits from my own kitchen

BREADS.

	986. Family loaf.	987. Graham loaf.	988. French rolls.	989. Beaten rolls.	990. Sweet buns.	991. Sugar cakes.
Dry substance.						
Ash	1.86	1.80	1.91	1.55	2.15	.78
Fat	.95	1.00	3.41	5.65	6.18	11.30
Sugars, &c.	3.45	4.37	4.29	5.21	10.89	27.60
Dextrine	4.55	4.90	4.10	3.64	4.37	2.01
Starch	75.00	72.87	71.69	68.94	64.40	46.83
Soluble albuminoids	1.90	3.01	3.44	1.56	2.64	2.60
Insoluble albuminoids	10.93	10.27	9.78	10.65	8.93	5.74
Fiber	1.36	1.78	1.38	2.81	.44	3.14
	100.00	100.00	100.00	100.00	100.00	100,00
Nitrogen	2.05	2.12	2.11	1.96	1.85	1.33
Total albuminoids	12.83	13.28	13.22	12.21	11.57	8.34
Per cent. of crust	55.65	56.50	64.93	50.44	62.10	.....
Original substance.						
Water	37.30	37.88	32.24	24.21	26.99	8.79
Ash	1.17	1.12	1.29	1.17	1.57	.71
Fat	.60	.62	2.31	4.28	4.51	10.31
Sugars, &c.	2.16	2.71	2.91	3.95	7.95	25.18
Dextrine	2.85	3.04	2.78	2.76	3.19	1.83
Starch	47.03	45.27	48.58	52.25	47.02	42.71
Soluble albuminoids	1.19	1.87	2.33	1.18	1.93	2.37
Insoluble albuminoids	6.85	6.38	6.63	8.07	6.52	5.24
Fiber	.85	1.11	.93	2.13	.32	2.86
	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	1.29	1.32	1.43	1.48	1.35	1.22
Total albuminoids	8.04	8.25	8.96	9.25	8.45	7.61

FLOURS.

	992. Molasses cakes.	1121. Bread, John D.	1122. Flour, John D.	1135. Eagle Bluff Spring.	1136. Red River Spring.	1137. Wife's Delight Spring.
Dry substance.						
Ash	2.38	2.56	.68	.91	.58	.46
Fat	4.37	1.09	1.09	1.52	1.23	1.32
Sugars, &c.	36.08	4.69	1.36	2.17	2.34	1.85
Dextrine	3.56	6.42	4.14	2.19	1.18	1.76
Starch	45.19	73.29	79.65	79.00	81.43	83.17
Solnble albuminoids	.90	.92	2.90	2.90	2.61	3.39
Insoluble albuminoids	7.97	10.15	9.23	10.88	9.74	7.60
Fiber	.45	.88	.45	.43	.89	.45
	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	1.27	1.76	1.95	2.20	1.98	1.75
Total albuminoids	7.97	11.07	12.13	13.78	12.35	10.99
Original substance.						
Water	10.22	30.32	12.00	12.30	13.55	12.40
Ash	2.14	1.79	.60	.80	.50	.40
Fat	3.93	.76	.96	1.33	1.06	1.16
Sugars, &c.	32.39	3.27	1.64	1.90	2.02	1.62
Dextrine	3.20	4.47	3.64	1.92	1.02	1.54
Starch	40.57	51.07	70.08	69.29	70.40	72.86
Soluble albuminoids	.00	.64	2.56	2.54	2.26	2.97
Insoluble albuminoids	7.15	7.07	8.12	9.54	8.42	6.66
Fiber	.40	.61	.40	.38	.77	.39
	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	1.14	1.23	1.71	1.93	1.71	1.54
Total albuminoids	7.15	7.71	10.68	12.08	10.68	9.63

FLOURS.

	1138. Richmond Wiuter.	1139. E. A. S. Ind. Winter.	1140. Red S. Ohio Winter.	1177. White Loaf.	1178. Graham bread.	1179. Flour 1177.
Dry subseance.						
Ash	.62	.73	.73	1.75	2.81	.51
Fat	1.48	1.61	1.52	.52	1.22	1.37
Sugars, &c	1.86	1.74	1.80	2.44	5.73	1.97
Dextrine	1.84	2.30	2.34	5.20	4.80	2.36
Starch	82.22	82.89	80.62	75.82	69.53	78.93
Soluble albuminoids	4.79	2.33	3.83	2.02	1.88	2.24
Insoluble albuminoids	6.74	7.95	8.57	11.19	12.17	10.59
Fiber	.45	.45	.59	1.06	1.86	2.03
	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	1.84	1.64	1.99	2.11	2.25	2.05
Total albuminoids	11.53	10.28	12.40	13.21	14.05	12.83
Original substance.						
Water	11.95	11.40	11.05	36.07	33.22	11.70
Ash	.55	.65	.65	1.12	1.88	.45
Fat	1.30	1.43	1.35	.33	.81	1.21
Sugars, &c	1.64	1.54	1.60	1.56	3.83	1.74
Dextrine	1.62	2.04	2.08	3.33	3.20	2.08
Starch	72.39	73.44	71.71	48.47	46.43	69.70
Soluble albuminoids	4.22	2.06	3.41	1.29	1.26	1.98
Insoluble albuminoids	5.93	7.04	7.62	7.15	8.13	9.35
Fiber	.40	.40	.53	.68	1.24	1.79
	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	1.62	1.46	1.76	1.35	1.50	1.82
Total albuminoids	10.15	9.10	11.03	8.44	9.39	11.38

FLOURS.

	1180. Bran 1178.	1181. Biscuit, Wisery.	1182. Flour, Wisery.	1194. Biscuit, Wisery.	1195. Loaf, Wisery.	1196. Flour, Wisery.
Dry substance.						
Ash	.77	1.37	.45	.11	1.20	.55
Fat	5.58	3.61	1.49	5.08	4.74	1.21
Sugars, &c	7.21	4.27	1.55	3.88	3.42	2.17
Dextrine	3.69	6.80	2.02	8.55	8.89	2.30
Starch	59.27	71.73	81.55	68.47	68.88	80.89
Soluble albuminoids	1.86	1.47	3.58	1,35	1.75	2.74
Insoluble albuminoids	13.06	10.18	8.63	11.22	10.13	9.88
Fiber	8.56	.57	.73	1.34	.99	.31
	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	2.39	1.86	1.96	2.01	1 90	2.01
Total albuminoids	14.92	11.65	12.21	12.57	11.88	12.57
Original substance.						
Water	8.50	33.40	11.10	34.69	32.94	9.55
Ash	.70	.91	.40	.07	.81	.50
Fat	5.11	2.41	1.32	3.32	3.18	1.09
Sugars, &c	6.60	2.84	1.38	2.53	2.29	1.96
Dextrine	3.38	4.53	1.80	5.58	5.96	2.08
Starch	54.23	47.77	72.50	44.72	46.19	73.16
Soluble albuminoids	1.70	.98	3.18	,88	1.18	2.48
Insoluble albuminoids	11.95	6.78	7.67	7.33	6.79	8.90
Fiber	7.83	.38	.65	.88	.66	.28
	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	2.18	1.24	1.74	1.32	1.27	1.82
Total albuminoids	13.65	7.76	10,85	8.21	7.97	11.38

The flours, as a whole, contain, average albuminoids, 10.69 per cent., and the difference between those from spring and winter wheats is small—10.65 winter, and 10.79 spring. They may be said, as far as the analyses go, to be equally good.

Considered in comparison with Hungarian flours, they are low in albuminoids, but this might be expected from our previous experience with wheats. Taken by themselves, they show a rather wide variation the highest having 12.08 per cent., and the lowest 9.10 per cent., the greatest variation being among the spring wheats. The average seems to be as high as could be expected from the wheats which we have analyzed from the sections from which these flours came, there being always a slight falling off in the amount of nitrogen in the best flour from that in the grain.

In their other constituents the flours show a plain and marked decrease, as compared to the grain, in ash and fat, these two substances being contained in much larger amount in the outer coats of the grain which are removed than in the portion which forms the flour. The fiber, for the same reason, is, as we should expect, much smaller.

The amount of starch necessarily increases proportionately as the other constituents diminish.

The average of all these flours is compared below, with analyses of Hungarian flours given by Horsford.

	American.	1. Imp. Extra.	4. Roll flour.	6. Bread flour.
Water	11.67	10.62	10.42	10.75
Ash	.54	.42	.59	.76
Oil	1.25			
Sugars	1.71			
Dextrine	1.79			
Starch	71.72	71.02	67.30	65.63
Soluble albuminoids	2.80			
Insoluble albuminoids	7.90			
Fiber	.62			
Total albuminoids	10.70	11.56	12.37	14.56

The original Hungarian wheat containing 14 per cent. of albuminoids and the average American certainly not more than 12 per cent., it appears that our flours are related to our wheat in fully as advantageous manner as the Hungarian, if they can be considered as corresponding either to the Imperial Extra or Roll flours, which seems allowable.

Kedzie and Atwater have analyzed twenty-eight flours from Michigan, Kansas, Minnesota, and Connecticut, and the results have been collected by Dr. Jenkins in the Report of the Connecticut Agricultural Station for 1879.

Kedzie found that the flours from spring wheats contained more albuminoids than those from winter wheats, but the average for all varieties is very nearly the same as for the flours which we have analyzed.

	Per cent
Kedzie's spring wheat flour	12.58
Kedzie's winter wheat flour	10.54
Average of twenty-eight flours	10.89
Average of Department of Agriculture flours	10.70

The flours are shown by Kedzie's analyses to be somewhat independent of the composition of the grain, but, as a rule, there is a greater or less loss of ash and albuminoids in the making of flour. His paper will be found in the Michigan Agricultural Report, 1877.

As has been said before, the condition of the nitrogen, or, rather, the amount present as gluten, has much to do with the quality of the flour for baking purposes.

In the six flours from Mr. Seitz's the gluten has been determined mechanically.

Gluten in flours.

No.	Name.	Nitrogen.	Albuminoids.	Moist gluten.	Dry gluten.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
1135	Eagle Bluff, Illinois Spring	1.93	12.08	39.46	12.98
1136	Red River, Minnesota Spring	1.71	10.68	7.32	2.80
1137	Wife's Delight, Wisconsin Spring	1.54	9.63	24.89	10 30
1138	Richmond, Virginia Winter	1.62	10.15	28.13	10.37
1139	E. A. Schriver, Maryland Winter	1.46	9.10	25.14	9.92
1140	Red "S," Ohio Winter	1.76	11.03	31.20	11.67
	Average	1.67	10.45	26.02	9.67

The Hungarian flours, according to Horsford, average 37 per cent. of moist gluten, so that ours, with the exception of that from Illinois spring wheat, are below the average.

That from Minnesota wheat would certainly make a poor bread and must have deteriorated by keeping.

Kedzie's determinations of gluten in sixteen flours, having an average of 10.69 per cent. albuminoids, showed an average of only 10.72 per cent. of gluten, slightly better than in the Washington flours, but still low. Under these circumstances, the question arises, can we have as good bread, that is to say, as light flours and palatable as the Vienna? Although Horsford sees no reason why we cannot, it seems to me that while our wheats and consequently our flours remain so poor in gluten we cannot, without particular care to find such a brand as the "Eagle Bluff," and even that would probably vary on every grinding.

In the analyses of different grades of Hungarian flour which were mentioned above, the decrease in amount of the albuminoids in the higher grades is apparent.

The difference between the flour and the bran which is mixed with it at the Kraft bakery shows that the same is true in our mill products and that the Graham bread contains the greater percentage of albuminoids, and the same would be found to be true in regard to the valuable ash constituents. It has been a moving question for a long time

whether this ought not to be avoided and whole flour preferred to that which has been so highly elaborated.

Recent experiments by Dr. Max Rubner, published in the Zeitschrift für Physiologische Chemie, 1883, p. 45, seem to prove that, in addition to the argument in favor of white bread on account of its palatability and many other advantages, it is, in fact, much more thoroughly digested, and consequently is really cheaper, weight for weight, to the poor man than the bread made with unbolted flour. We can only hope, then, for an improvement in the character of our wheats to add to their nitrogen content, and to improved methods of milling which we are fast becoming possessed of, to make it possible to produce a flour with the highest amount of nitrogen in the higher grades, and at the same time with it in the best physical condition. Then we may expect to improve our breads.

CHEMICAL COMPOSITION OF BREADS, ETC.

The changes which take place in flour during its conversion into various forms of bread and cake is well illustrated in the analyses given in the table.

The amount of water in the numerous kinds analyzed extends from nearly 38 in the breads to 9 per cent. in the sugar cakes, the beaten rolls and buns occupying a medium position. The amount of water, however, decreases very rapidly on exposure to the air, as the following determinations in a white and Graham loaf show, and in some rolls of domestic make:

WHITE LOAF FROM KRAFT'S BAKERY.

(Serial No. 1177.)

	Weight.	Per cent. lost of the total water present.	Per cent of water in the bread on the day named.
On leaving bakery:	*Grams.*		
August 22	452		36.07
On exposure:			
August 23	422	18.39	31.51
August 24	390	38.04	25.90
August 25	379	44.77	23.75
August 26	364	53.98	20.60
August 27			
August 28	346	65.01	16.47
August 29	333	73.00	12.91
August 30	326	77.27	11.35
August 31	323	79.12	10.52
September 1	318	82.17	9.12
September 6	307	88.97	5.86

After drying two weeks there had disappeared all but 11.03 per cent. of the original water, and the air dry material only contained 5.86 per cent. of water.

GRAHAM LOAF FROM KRAFT'S BAKERY.

(Serial No. 1178.)

	Weight.	Per cent. lost of total water present.	Per cent. water in bread.
On leaving bakery:	*Grams.*		
August 22	464	.....	33.22
On exposure to air:			
August 23	440	15.58	29.55
August 24	412	33.77	24.75
August 25	403	39.61	23.07
August 26	384	51.95	19.27
August 27	.....	.....	.....
August 28	369	61.69	15.99
August 29	355	70.78	12.68
August 30	350	74.02	11.43
August 31	346	76.62	10.40
September 1	338	81.82	8.28
September 6	323	85.06	4.02

BREAKFAST ROLLS.

(Serial No. 1194.)

	Weight.	Per cent. lost of total water present.	Per cent. water in bread.
On leaving oven:	*Grams.*		
August 23	364	.....	34.69
On exposure:			
August 24	328	28.50	27.44
August 25	314	39.59	23.17
August 26	293	57.00	18.77
August 27	.....	.....	.....
August 28	277	68.88	14.08
August 29	266	77.59	10.53
August 30	261	81.55	8.81
August 31	259	83.14	8.11
September 1	259	83.14	8.11
September 6	256	85.51	7.03

The loaf breads dry more thoroughly, but do not lose their water as rapidly at first as the rolls. The rolls, it may be said, which were used in this experiment, were eight in number from a pan of twenty, and were not broken apart during the course of exposure.

The changes of a chemical nature displayed are those which are already tolerably well known, namely, the conversion of some of the starch by fermentation into sugar, and by baking into dextrine.

The albuminoids which in the flour are soluble in alcohol become insoluble, showing that change has taken place in the gluten.

The apparent increase in ash and fat is, of course, due to salt and butter or lard added in making the dough.

CORN (MAIZE).

The varieties of maize or corn which have been analyzed by us and by other investigators whose analyses have been collected include—

Dent: Red, Yellow, White, and Miscegenation;

Flint: Yellow, White, Blue Mexican, and Miscegenation; and

Sugar or sweet corn.

They amount to one hundred and thirty-three in number, of which thirty-two field and three sugar corns are by Johnson, Atwater, and Kedzie.

The latter have been included, with proper acknowledgment, among our analyses, as a valuable addition to our data for the calculation of local averages.

The specimens which we have had in hand are for the most part sufficiently accurately identified in the tables of analyses. It is only necessary to add that Nos. 18–24 Sugar corns were of the Department distribution of seed in 1878. Nos. 31, 33, 34, 36, 37, 38, 39, 40, 42, 43, 44, 45 were collected by the New Hampshire Board of Agriculture in 1878.

Nos. 1244–1254, 1256–1271 were from the Missouri Agricultural College in 1879.

No. 1255 was from V. W. Metcalf, Hopkinsville, Ky., in 1879.

Nos. 1272, 1273, 1275, 1277 were from the Eastern Experimental Farm, Chester County, Pennsylvania, in 1879.

Nos. 1945–1967 were from the exhibit of the Texas and Pacific Railroad in the Department museum.

Nos. 1961–1967 were from the exhibit of the Atchison, Topeka and Santa Fé Railroad.

Nos. 1968–1970 were from the exhibit of the Texas and Arkansas Railroad.

Most of these samples had been preserved some time before they came into our hands, and had, consequently, dried out, making the determinations of moisture rather lower than would be found in fresh corn.

The specimens, it will be seen, are not from so many localities as the wheats, but they are widely scattered and furnish data which are entirely suited for a study of the variations in composition and for a comparison with wheat.

The methods of analysis have been exactly the same as were used with wheat, and the more detailed analyses of corn correspond in every particular with those, made in the same way, of wheat.

RESULTS.

The results upon which the conclusions in regard to corn are based are arranged in the following tables by States, in the same way as was done with the analyses of wheats. They explain themselves.

Number.	Name.	Variety.	Date.	Weight of 100 kernels.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Analyst.
	NEW HAMPSHIRE:			*Grams.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	
31	Small Eight-rowed	White Corn	1878		11.05	1.57	4.80	67.63	1.30	13.65	2.18	Dep't of Agric.
33	Adam's	Yellow Corn	1878	.....	8.61	1.57	4.83	73.30	1.19	10.50	1.68	Do.
34	Canada	....do	1878	.....	8.27	1.72	5.60	71.79	1.36	11.36	1.82	Do.
36	Small Twelve-rowed	....do	1878	.....	11.48	1.34	6.03	69.56	1.09	10.50	1.68	Do.
37	State Fair Premium	....do	1878	.....	10.19	1.78	5.29	70.86	1.06	10.82	1.74	Do.
38	Large Premium	....do	1878	.....	10.00	1.46	5.52	70.57	1.09	11.36	1.82	Do.
39	Board of Agriculture	....do	1878	.....	11.09	1.31	4.68	70.55	.82	11.55	1.85	Do.
40	King Philip	Red Corn	1878	.....	10.23	1.84	7.05	67.79	1.01	12.08	1.93	Do.
42	Miscegenation	White and Blue	1878	.....	9.92	1.63	5.33	70.35	1.05	11.72	1.88	Do.
43	Pitch Knot	.....	1878	.....	11.24	1.52	5.26	69.74	1.04	11.20	1.79	Do
44	Tom Thumb Pop	Yellow Corn	1878	.....	9.05	1.60	5.89	69.53	1.33	12.60	2.02	Do.
	VERMONT:											
35	Vermont	Yellow Corn	1878	.....	8.64	1.45	5.63	72.76	1.38	10.14	1.62	Dep't of Agric.
	PENNSYLVANIA:											
28	White Prolific	White Corn	1878	.....	8.96	1.43	5.82	74.49	1.25	8.05	1.29	Dep't of Agric.
32	Compton's Early	Yellow Corn	1878	.....	6.59	1.64	5.30	74.48	2.09	9.90	1.59	Do.
1235	Pride of North	....do	1882	30.610	8.60	1.25	4.65	73.10	2.25	10.15	1.62	Do.
1259	Chester County Mammoth	Yellow Dent	.....	44.147	7.80	1.40	4.82	74.90	2.33	8.75	1.40	Do.
1272	Field Corn	Red Dent	.....	37.202	7.85	1.45	5.49	75.73	1.95	7.53	1.20	Do.
	NORTH CAROLINA:											
26	White Dent	White Dent	1878	.....	6.74	1.43	5.18	74.09	1.53	11.03	1.76	Dep't of Agric.
	KENTUCKY:											
1255	Willis	White Dent	.....	32.457	7.70	1.50	5.33	73.47	2.20	9.80	1.57	Dep't of Agric.
	TENNESSEE:											
25	Improved Prolific	White Corn	1878	.....	7.58	1.23	5.09	74.16	2.65	9.29	1.48	Dep't of Agric.
	MISSOURI:											
1244	Tuscarora	White Flint	.....	35.582	7.70	1.85	5.34	71.65	2.08	11.38	1.82	Dep't of Agric.
1245	Proctor's Bread	White Dent	.....	30.837	7.90	1.65	4.65	74.12	2.05	9.63	1.54	Do.
1246	Long John	....do	.....	41.089	8.05	1.75	4.87	72.22	2.08	11.03	1.76	Do.
1247	Saint Charles	....do	.....	34.183	8.20	1.75	6.29	72.43	3.10	8.23	1.32	Do.
1248	Snow Flake	....do	.....	52.679	7.80	1.65	4.34	74.83	1.75	9.63	1.54	Do.
1249	Ragan's White	....do	.....	39.672	8.25	1.80	6.14	70.18	2.60	11.03	1.76	Do.
1250	Peabody	....do	.....	32.323	7.95	2.05	7.49	69.93	2.60	9.98	1.60	Do.
1251	Badeau	....do	.....	37.011	8.45	2.10	5.82	69.85	2.93	10.85	1.74	Do.
1252	Blount's Prolific	....do	.....	38.753	8.05	2.05	5.33	70.34	1.98	12.25	1.96	Do.
1253	White Flint	White Flint	.....	34.958	7.60	1.55	4.93	71.52	2.50	11.90	1.90	Do.
1254	Thompson's	White Dent	.....	43.662	8.30	1.80	4.94	69.78	2.58	12.60	2.02	Do.
1256	Ragan's Yellow	Yellow Dent	.....	42.651	8.50	1.45	4.85	73.44	2.13	9.63	1.54	Do.

Number.	Name.	Variety.	Date.	Weight of 100 kernels.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Analyst.
	MISSOURI—Continued.			*Grams.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	
1257	Chester County	Yellow Dent	.....	33.595	8.05	1.45	6.31	70.69	2.65	10.85	1.74	Dep't of Agric.
1258	Golden Yellow	..... do	.....	35.343	8.30	1.60	5.38	72.79	1.43	10.50	1.68	Do.
	CONNECTICUT:											
	Vermont White Cap	Flint Corn	1877	.....	10.86	1.53	4.29	71.22	1.04	11.06	1.76	S. W. Johnson.
	Rowley	.....do	1877	.....	11.00	1.61	4.83	70.15	.78	11.63	1.86	Do.
	Yellow Rowed or Canada	.....do	.....	.....	15.10	1.36	5.31	66.98	1.24	10.01	1.60	W. O. Atwater.
	Old Fashioned Yellow	.....do	1878	.....	10.58	1.43	4.68	72.11	1.39	9.81	1.57	S. W. Johnson.
	Ohio Dent	Dent Corn	1877	.....	10.78	1.37	5.14	71.30	1.35	10.06	1.76	Do.
	Coe's Prolific	.....do	1878	.....	9.55	1.45	3.98	72.70	2.19	10.13	1.62	Do.
	Benton	.....do	1878	.....	10.70	1.57	5.00	71.40	1.36	9.97	1.60	Do.
	Scioto	.....do	1878	.....	10.43	1.53	4.01	72.98	1.80	9.25	1.48	Do.
	White Ohio	.....do	1878	.....	9.70	1.79	4.20	71.30	1.73	11.28	1.80	Do
	Wisconsin	.....do	1878	.....	9.72	1.56	4.89	70.17	2.06	11.60	1.85	Do.
	White Prolific	.....do	1878	.....	10.14	1.67	4.28	73.38	1.34	9.19	1.47	Do.
	Extra Early Adam's	.....do	1878	.....	10.94	1.75	4.81	70.21	1.48	10.81	1.73	Do.
	Tuscarora	Unclassified	1877	.....	11.25	1.47	5.74	68.82	1.28	11.44	1.83	Do.
	NORTH CAROLINA:											
	North White	Flint Corn	.....	.....	11.17	1.31	4.70	70.04	1.90	10.88	1.74	S. W. Johnson.
	INDIANA:											
	White Oil	Dent Corn	.....	.....	11.29	1.28	4.87	70.16	1.90	10.50	1.68	R. C. Kedzie.
	MICHIGAN:											
	Smut Nose	Flint Corn	.....	.....	12.90	1.54	4.94	66.81	2.00	11.81	1.89	R. C. Kedzie.
	Do	.....do	.....	.....	13.26	1.49	5.14	66.11	2.49	11.51	1.84	Do.
	Eight-rowed Flint	.....do	.....	.....	13.45	1.43	4.83	66.03	2.26	12.00	1.92	Do.
	Sanford	.....do	.....	.....	13.37	1.37	5.06	67.41	2.10	10.69	1.71	Do.
	Yellow Dent	Dent Corn	1877	.....	12.74	1.41	4.63	66.98	2.49	11.75	1.88	Do.
	Do	.....do	1877	.....	11.66	1.51	5.07	67.80	2.48	11.48	1.51	Do.
	White Dent	.....do	1877	.....	13.73	1.60	4.63	66.26	2.26	11.52	1.52	Do.
	Hackberry Dent	.....do	1877	.....	12 47	1.47	4.77	69.11	2.30	9.88	1.58	Do.
	Strawberry Roan	.....do	1877	.....	14.05	1.39	4.59	67.63	2.03	10.31	1.65	Do.
	Pony Dent	.....do	.....	.....	13.42	1.40	4.83	66.94	2.16	11.25	1.80	Do.
	Do	.....do	.....	.....	13.29	1.31	5.03	67.53	2.21	10.63	1.70	Do.
	Tuscarora	White Flint	1877	.....	14.08	1.52	5.77	65.97	1.80	10.86	1.74	Do.
	UNKNOWN:											
	Western Yellow	Flint Corn	.....	.....	13.93	1.25	3.92	70.49	1.59	8.82	1.41	W. O. Atwater.
	Southern White	.....do	.....	.....	13.82	1.32	4.02	71.16	.88	8.80	1.41	Do.
	Early Dutton	.....do	.....	.....	8.08	1.52	5.64	72.62	2.52	9 62	1.54	Do.
	Common Yellow, or Canada	.....do	.....	.....	10.52	1.31	4.42	71.63	2.40	9.72	1.56	Do.

	King Philip, or Rhode Island	do			9.79	1.60	4.45	70.08	2.21	11.87	1.90	Do.
	MISSOURI:											
1260	Pennsylvania	Yellow Flint		30.674	8.25	1.55	4.05	74.27	1.90	9.98	1.60	Dep't of Agric.
1261	Pale Yellow	Yellow Dent		44.251	8.55	1.65	5.16	72.29	2.55	9.80	1.60	Do.
1262	Golden Dent			35.336	7.50	1.50	4.76	71.51	1.95	12.78	2.04	Do.
1263	Early Canada	Yellow Flint		37.077	8.70	1.45	4.67	72.50	2.00	10.68	1.71	Do.
1264	Chester County Mammoth	Yellow Dent		39.807	7.60	1.85	6.93	70.34	2.95	10.33	1.65	Do.
1265	New Madrid	do		32.031	7.40	1.50	5.81	71.96	2.65	10.68	1.71	Do.
1266	Early Yellow	do		39.624	7.90	1.75	5.43	73.41	2.58	8.93	1.43	Do.
1267	Evans	do		40.962	9.05	1.50	4.73	73.24	2.55	8.93	1.43	Do.
1268	Gold Dust	do		43.263	8.75	1.55	4.95	70.92	2.28	11.55	1.85	Do.
1269	Bloody Butcher	Red Dent		37.774	8.70	1.70	4.78	72.61	2.23	9.98	1.60	Do.
1270	Long Yellow	Yellow Dent		38.062	8.80	1.30	4.88	73.04	2.00	9.98	1.60	Do.
1271	Jersey Red	Red Dent		45.870	8.30	1.75	4.39	72.26	2.45	10.85	1.74	Do.
	KANSAS:											
1962	Yellow Dent			34.436	11.84	1.69	5.11	68.82	2.04	10.50	1.68	Dep't of Agric.
1963	Striped Red and Yellow Dent			32.206	12.10	1.60	4.66	69.09	2.40	10.15	1.62	Do.
1964	Dark Red Dent			32.150	12.26	1.36	4.47	68.93	2.65	10.33	1.65	Do.
1965	White Dent			35.798	12.06	1.56	5.69	68.44	2.10	10.15	1.62	Do.
1966	Yellow Dent			28.348	11.40	1.30	4.77	71.72	1.71	9.10	1.46	Do.
1967	White Dent			36.687	12.00	1.44	4.49	69.34	2.05	10.68	1.71	Do.
	COLORADO:											
1237	Blount's Prolific	Flint	1882	34.120	10.50	1.50	5.66	70.19	2.35	9.80	1.60	Dep't of Agric.
	TEXAS:											
1279	Wild Goose			43.799	8.40	1.45	4.91	72.71	2.20	10.33	1.65	Dep't of Agric.
1945	White and Yellow Dent Cross			31.364	10.10	1.44	5.33	68.96	3.84	10.33	1.65	Do.
1946	White Dent			40.926	9.70	1.70	5.10	69.25	3.22	11.03	1.76	Do.
1947	Red and Yellow Cross Dent			38.517	10.00	1.40	5.42	71.38	1.82	9.98	1.60	Do.
1948	Yellow and White Dent			38.465	10.36	1.04	5.29	70.02	2.61	10.68	1.71	Do.
1949	Red Dent			40.245	10.44	1.44	5.62	69.67	2.68	10.15	1.62	Do.
1950	White, Red, and Yellow Dent			36.366	10.52	1.60	5.20	68.07	4.81	9.80	1.57	Do.
1951	White Dent			40.881	10.84	1.56	5.57	69.12	2.41	10.50	1.68	Do.
1952	Do			40.435	10.60	1.32	5.32	67.74	4.17	10.85	1.74	Do.
1953	Yellow, Red, and White Dent			38.855	10.42	1.40	5.48	70.49	2.06	10.15	1.62	Do.
1954	White Dent			39.986	10.20	1.63	5.26	69.92	2.31	10.68	1.71	Do.
1955	Red and White Dent			31.547	10.14	1.38	4.97	70.78	2.40	10.33	1.65	Do.
1956	Yellow, Red, and White Dent			39.655	10.90	1.30	5.75	69.06	2.66	10.33	1.65	Do.
1557	Yellow, White, and Red Dent			38.526	10.05	1.49	5.36	70.19	2.23	10.68	1.71	Do.
1958	Do			39.583	10.49	1.52	5.58	69.65	2.96	9.80	1.57	Do.
1959	Yellow and White Dent			39.195	9.27	1.38	6.11	70.95	2.14	10.15	1.62	Do.
1960	White Dent			36.150	10.50	1.42	5.51	69.34	2.55	10.68	1.71	Do.
1968	Yellow Dent			32.398	11.98	1.32	5.15	67.79	2.73	11.03	1.76	Do.
1969	Yellow, Red, and White Dent			38.871	12.13	1.37	6.57	66.69	2.91	10.33	1.65	Do.
1970	White Dent			30.898	11.82	1.18	5.46	68.63	2.76	10.15	1.62	Do.
	OREGON:											
30	Oregon White	White Corn	1878		9.25	1.46	7.08	73.07	1.26	7.88	1.26	Dep't of Agric.
	WASHINGTON TERRITORY:											
1236	Yakima City	Flint	1882	27.900	10.30	1.50	5.73	71.19	2.88	8.40	1.34	Dep't of Agric.
	MEXICO:											
27	White Mexican	White Corn	1878		8.65	1.87	4.90	72.79	1.64	10.15	1.62	Dep't of Agric.
29	Mexican White Dent	White Dent	1878		11.14	1.45	6.28	68.87	1.59	10.67	1.71	Do.
41	Mexican	Blue Corn	1878		8.97	1.42	5.25	72.35	1.80	10.21	1.63	Do.

ANALYSES OF AMERICAN CORN BY STATES—CONTINUED.

Number.	Name.	Variety.	Date.	Weight of 100 kernels.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Analyst.
				Grams.	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*	
	UNKNOWN:											
1224	Queen of the Prairie	Field Corn, Department Seed	1882	25.782	9.40	1.55	4.29	71.06	2.85	10.85	1.74	Dep't of Agric.
1274	Mexican No. 9	Blue, Black, Red, and White Corn, Department Seed.	.....	23.605	8.35	1.75	7.13	73.74	2.03	7.00	1.12	Do.
1278	Mexican	Flint Corn, Department Seed	.....	40.734	7.95	1.30	5.53	74.62	2.20	8.40	1.34	Do.
45	Pop Corn	White, Department Seed ...	1878	.....	8.61	1.63	5.63	68.68	2.32	13.13	2.10	Do.

Number.	Name.	Locality.	Date.	Weight of 100 kernels.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Analyst.
				Grams.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	
18	Stowell's Evergreen	New England	1878	.....	5.98	1.92	8.00	69.53	2.66	11.91	1.90	Dep't of Agric.
21	Golden	Massachusetts	1878	.....	6.27	1.93	9.17	66.70	1.58	14.35	2.30	Do.
22	Marblehead Mammoth	... do	1878	.....	6.47	1.92	9.00	67.95	1.88	12.78	2.04	Do.
24	Proctor's	... do	1878	.....	10.13	1.92	7.95	66.17	1.75	12.08	1.93	Do.
1273	Black Sugar	Pennsylvania	.....	27.392	8.50	1.90	8.88	65.81	3.53	11.38	1.82	Do.
1275	Darling's Sugar	... do	.....	21.635	7.80	1.95	9.08	67.64	3.03	10.50	1.68	Do.
1276	Egyptian	....do	.....	25.359	7.40	1.70	8.08	68.01	3.08	11.73	1.88	Do.
1277	Stowell's Evergreen	....do	.....	23.478	7.00	2.35	11.89	62.45	4.58	11.73	1.88	Do.
19	Egyptian	Maryland	1878	.....	7.54	1.92	7.80	69.17	2.02	11.55	1.85	Do.
1220	Stowell's Evergreen	Department Seed	1882	15.717	7.85	2.25	7.83	69.12	3.50	9.45	1.51	Do.
1221	Roslyn Hybrid	....do	1882	24.319	7.85	1.75	8.77	66.41	5.24	9.98	1.60	Do.
1222	Early Minnesota	....do	1882	29.251	9.50	2.10	9.12	65.56	3.14	10.58	1.69	Do.
1223	Egyptian	....do	1882	16.475	8.10	2.15	7.96	68.05	3.76	9.98	1.60	Do.
1961	Sugar Corn	Kansas	.....	16.501	10.76	1.90	8.06	65.85	3.10	10.33	1.65	Do.
20	Red River	Minnesota	1878	.....	9.13	1.89	9.31	66.48	1.46	11.73	1.88	Do.
23	Prolific		1878	.....	10.38	1.87	7.65	67.73	2.04	10.33	1.65	Do.
	Sweet	Connecticut	1877	.....	9.45	2.06	9.13	63.05	1.93	14.38	2.30	S. W. Johnson.
	Stowell's Evergreen	....do	.....	.....	10.86	1.89	7.66	65.86	2.63	11.10	1.61	W. O. Atwater.
	Mammoth	....do	1878	.....	9.43	1.93	7.48	66.00	2.75	12.32	1.98	S. W. Johnson.

AVERAGES.

From the preceding results, averages have been calculated as in the case of wheat. The sugar corns are not included, as it will be seen that they are of quite a different composition from field corn and should be therefore considered by themselves.

AVERAGE COMPOSITION OF AMERICAN CORN (MAIZE).

	Weight of 100 kernels.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Weight of largest 100 kernels.	Weight of smallest 100 kernels.	Highest albuminoids.	Lowest albuminoids.	No. of analyses.	No. of weights of 100 kernels.	Analyst.
	Grams.	*Pr. ct.*	*Pr.ct.*	*Pr.ct.*	*Pr. ct.*	*Pr.ct.*	*Pr. ct.*	*Pr.ct.*	*Grams.*	*Grams.*	*Pr. ct.*	*Pr. ct.*			
America	36.910	10.04	1.52	5.20	70.69	2.09	10.46	1.67	52.679	23.605	13.65	7.00	114	61	
Northern States	37.320	9.98	1.54	5.11	71.32	1.41	10.64	1.70	44.147	30.610	13.65	7.53	30	3	
South		8.96	1.37	4.94	72.06	1.72	10.95	1.75			11.03	10.88	2		
Middle West	32.457	12.33	1.43	4.97	68.16	2.22	10.89	1.70			12.00	9.29	15	1	
Far West	37.528	9.50	1.55	5.30	70.75	2.47	10.43	1.67	52.679	28.348	12.78	8.23	53	53	
Pacific slope	27.900	9.78	1.48	6.40	72.13	2.07	8.14	1.30			8.40	7.88	2	1	
Mexico		9.58	1.58	5.48	71.34	1.68	10.34	1.65			10.67	10.15	3		
New Hampshire		10.10	1.58	5.48	70.15	1.11	11.67	1.85			13.65	10.50	11		Department of Agriculture.
Vermont		8.64	1.45	5.63	72.76	1.38	10.14	1.62					1		Do.
Connecticut		10.84	1.54	4.70	70.98	1.46	10.48	1.69			11.63	9.19	13		S. W. Johnson, W. O. Atwater.
Pennsylvania	37.320	7.96	1.43	5.22	74.54	1.97	8.88	1.42	44.147	30.610	10.15	7.53	5	3	Department of Agriculture.
North Carolina		8.96	1.37	4.94	72.06	1.72	10.95	1.75			11.03	10.88	2		Johnson and Dept.
Kentucky	32.457	7.70	1.50	5.33	73.47	2.20	9.80	1.57					1		Department of Agriculture.
Tennessee		7.58	1.23	5.09	74.16	2.65	9.29	1.48					1		Do.
Indiana		11.29	1.28	4.87	70.16	1.90	10.50	1.68					1		R. C. Kedzie.
Michigan		13.20	1.45	4.95	67.05	2.21	11.14	1.73			12.00	9.88	12		Do.
Missouri	38.411	8.18	1.68	5.28	72.00	2.33	10.54	1.68	52.679	30.674	12.78	8.23	26	26	Department of Agriculture.
Kansas	33.271	11.94	1.49	4.87	69.39	2.16	10.15	1.62	36.687	28.348	10.68	9.10	6	6	Do.
Colorado	34.120	10.50	1.50	5.66	70.19	2.35	9.80	1.60					1	1	Do.
Texas	37.833	10.44	1.42	5.45	69.52	2.77	10.40	1.66	43.799	30.898	11.03	9.80	20	20	Do.
Oregon		9.25	1.46	7.08	73.07	1.26	7.88	1.26					1		Do.
Washington Territory	27.900	10.30	1.50	5.73	71.19	2.88	8.40	1.34					1		Do.
Mexico		9.58	1.58	5.48	71.34	1.68	10.34	1.65			10.67	10.15	3		Do.

The average American corn as compared with the averages of foreign investigators, which no doubt include many of our corns, stands in quite a different position from wheat.

AVERAGE OF AMERICAN CORN COMPARED WITH AVERAGES OF FOREIGN INVESTIGATIONS.

	Richardson.	Koenig.	Wolff.
Water	10.04	13.12	14.40
Ash	1.52	1.51	1.50
Oil	5.20	4.62	6.50
Carbhydrates	70.69	68.41	62.10
Fiber	2.09	2.49	5.50
Albuminoids	10.46	9.85	10.00
	100.00	100.00	100.00
Nitrogen	1.67	1.58	1.60
Number of analyses	114	145	

There is no marked difference between the averages, except in the matter of water, where, as in wheat, our grain is much drier. The American corn is rather better than the foreign article, if anything.

In the averages for different sections of the country another fact is discovered which, after our experience with wheat, is still more surprising than the result of the comparison of American and foreign corns.

There is apparently the same average amount of ash, oil, and albuminoids in a corn wherever it grows, with the exception of the Pacific slope, where, as with wheat, there seems to be no facility for obtaining or assimilating nitrogen.

The amount of water is variable, but, as has been said, many of the samples had been on exhibition for a considerable time, and were consequently dried out.

The increase in the fiber from East to West is not paralleled in the wheat, but, as we have seen, is often a feature of increased vigor.

Corn is, then, an entirely different grain from wheat. It maintains about the same percentage of albuminoids under all circumstances, and is not affected by its surroundings in this respect.

A study of the averages for each State shows that the samples from Pennsylvania and from Oregon and Washington Territory fall much below the average and that those from New Hampshire rise above it. The preponderance of averages for single States which do not vary 1 per cent. proves, however, that corn is much more stable in its composition than wheat, even though New Hampshire contains an extreme of 11.67 per cent. average albuminoids, and Pennsylvania, Oregon, and Washington Territory, extremes of 8.88, 8.40, and 7.88 per cent.. Only two analyses have been made from the Pacific slope and more are needed for confirmation, but as the two analyses, like those of the wheats grown there, are low in albuminoids it may safely be assumed to be a characteristic of that portion of the country.

Having discussed the averages it is of interest to see how wide the variations in composition are:

VARIATIONS OR EXTREMES FOR EACH CONSTITUENT OF CORN.

Constituent.	Highest. percentage.	Lowest. percentage.	Variation.	Above average.	Below average.
Water	15.10	7.40	7.70	5.06	3.64
Ash	2.10	1.18	.92	.58	.34
Oil	7.49	3.92	3.57	2.29	1.28
Carbhydrates	75.73	65.97	9.76	5.04	4.72
Fiber	3.10	.78	2.32	1.01	1.31
Albuminoids	13.65	7.00	6.65	3.19	3.46
Weight of 100 kernels ..... grams..	53.679	23.605	29.074	15.769	13.305

The variation in water has been explained, that of ash is remarkably small, of oil and fiber proportionately the same as in wheat, while albuminoids has not nearly so wide a variation, and, in fact, in the analyses of the one hundred and fourteen corns only three contain less than 8 per cent., two more than 13 per cent., and seven more than 12 per cent., so that the usual limits may be said to lie between 8 and 12 per cent., and this is true of the analyses of foreign maize given by Koenig.

Our conclusion must be, then, that corn can supply itself with nitrogen under varied circumstances, but that it rarely is able to assimilate more than a certain amount, nor will it fall far below this amount. The bushels of crop may vary and the size of the grain, but the quantity of albuminoids is practically unchangeable.

Under these circumstances it is perhaps needless to say that there is but slight variation in composition between different kinds of corn.

Red Dent is slightly inferior, but the remaining varieties are practically of the same composition.

Sugar corn is, however, quite distinct from the field or hard corns. Its average composition compared with the average of all the hard corns shows a much higher percentage of oil and somewhat higher ash, fiber, and albuminoids. The grain dries out more than the field corn and weighs less.

AVERAGE COMPOSITION OF SUGAR AND FIELD CORN.

	Sugar.	Field.
Number of analyses	19	114
Water ..... per cent..	8.44	10.04
Ash ..... do....	1.97	1.52
Oil ..... do....	8.57	5.20
Carbhydrates ..... do....	66.72	70.69
Fiber ..... do ..	2.82	2.09
Albuminoids ..... do....	11.48	10.46
Nitrogen ..... do....	1.84	1.67
Weight of 100 kernels ..... grams..	22.236	.910

OTHER CEREALS THAN CORN AND WHEAT.

Sufficient analyses of other American cereals have not been made to determine what effect environment has had upon them. From foreign analyses it is possible to calculate the variations which are usually found, and it is fair to suppose that as the agreement is close with corn and wheat, it would be so in the remaining cereals. For this purpose the large collection by Koenig of analyses of cereals has been employed. The analyses of each serial are divided into percentages of the whole number made, according to the amount of albuminoids which they contain. It was then found that of this number 75 per cent. would fall within certain limits which might be regarded as the ordinary variation to be expected. The extremes are as follows:

Extremes of albuminoids in different cereals.

	For all analyses.		For 75 per cent. of the analyses.	
	Highest.	Lowest.	Highest.	Lowest.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Wheat	24	5	14	8
Barley	18	6	14	8
Oats	18	6	13.8	9
Rye	15	8	13	9.25
Corn	15	5	10	6.83

The probable variation in a wheat, therefore, is 6 per cent., barley 6 per cent., oats 4.8 per cent., rye 3.75 per cent., and corn 2.3 per cent.

Wheat and barley have the widest variation, followed by oats and rye, corn having the smallest.

It is apparent then that wheat and barley must be more susceptible to their supply of nitrogen than corn, which coincides with the results of Atwater's field experiments with various fertilizers. He found that corn responded less than other cereals to nitrogenous fertilizers.

In closing this paper it must be said that many of the conclusions arrived at in the preceding pages are not intended as final or advanced in the light of anything more than possible deductions from the data at hand. Their absolute truth can only be decided by a more extended investigation.

DEPARTMENT OF AGRICULTURE.
BUREAU OF CHEMISTRY.
BULLETIN No. 4.

AN INVESTIGATION

OF

THE COMPOSITION

OF

AMERICAN WHEAT AND CORN.

SECOND REPORT.

CLIFFORD RICHARDSON,
ASSISTANT CHEMIST.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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WASHINGTON, *September* 16, 1884.

SIR: I have the honor to present for publication the results of a continuation of the "Investigation of the Composition of American Wheat and Corn," the beginning of which appeared as Bulletin No. 1 of the Chemical Division of this Department.

Respectfully,

CLIFFORD RICHARDSON,
Assistant Chemist.

Hon. GEO. B. LORING,
Commissioner.

SCOPE OF THE INVESTIGATION FOR 1883–'84.

The investigation of the past year has been confined almost entirely to wheat and its products, previous analyses of corn having been sufficient in number to demonstrate the very universal uniformity of its composition. A number of weighings of varieties of the latter have been made, however, to obtain information as to the sizes of kernels grown in different portions of the country, and a few determinations of ash and albuminoids.

The wheats which have been analyzed, while including some scattered specimens, which have from time to time come to hand, have been principally from parts of the country which were not well represented in our previous report or where those which have been selected were deemed by good judges to be not truly characteristic of the State; as in the case of Minnesota. A selection from Professor Blount's crop of 1883 has also been examined, it being the third consecutive year in which Colorado varieties grown under his direction have been analyzed. The roller process of milling having attracted much attention and taken a prominent position in the methods of milling at the present day, a complete series of samples illustrative thereof has been supplied by C. A. Pillsbury & Co., of Minneapolis, and partial series by Warder & Barnett, of Springfield, Ohio, and Herr & Cissel, Georgetown, D. C., together with numerous flours from different millers in Minnesota and elsewhere, manufactured by gradual reduction.

The question of the susceptibility of flour and other grain products to the humidity of the atmosphere has also been a subject of consideration, and baking experiments with flours from various States and of different grades have been carried on for comparison with similar work done in England a few years ago in which some of our wheats were included.

LIST OF WHEATS.

Grown by Hugh L. Wysor, Newbern, Pulaski County, Virginia.

1844. *Dallas.*

Crop of 1883. Soil a very light sand; no fertilizers. The land has been in clover about four years; the clover had run out when the land was broken in the fall of 1882; sown broadcast and plowed in; no after-cultivation. Yield: Three-quarters winter killed; the remainder gave 15 bushels per acre, weighing 68 pounds per bushel.

1845. *Fultz-Clawson.*

Crop of 1883. Grown under the same conditions as the preceding.

Grown by Peter L. J. Cogan, Addison, Webster County, West Virginia.

1846. *Early Amber.*

Crop of 1883. Soil a loam with clay subsoil; no fertilizers; grain sown on corn stubble and plowed in with shovel-plow. Yield: 10 or 12 bushels per acre.

Grown by Jacob W. Wharton, Forney, Cherokee County, Alabama.

1847. *Dallas.*

Crop of 1883. Soil an upland, gravelly ridge; no fertilizer. The soil had been in cotton the previous year and the cotton was manured with a compost of phosphate, stable manure, and cotton-seed at the rate of 300 to 400 pounds per acre. The seed was put in as follows: A furrow was run under the cotton stalks, plowing them out, and the seed being put in was turned under with a horse-turner or sometimes a small scooter, plowing the land as thoroughly as possible. Yield: 10 to 12 bushels per acre, weighing 60 pounds per bushel.

1848. *Dallas.*

Crop of 1883. Like the previous sample, but grown in a valley on loam, not so gravelly, between a gray and red in color. Yield: The same.

Grown by R. W. Gibbins, Hot Springs, Garland County, Arkansas.

1849. *Red Mediterranean.*

Crop of 1883; soil, clay; no fertilizer; ground turned with a two-horse plow; wheat sowed broadcast and harrowed in; yield, 5 bushels, weighing 50 pounds.

Grown by J. P. Hooke, Maryville, Blount County, Tennessee.

1850. (*Name lost.*)

Crop of 1883; soil, a light clay; no fertilizer, the soil having been manured the previous spring and cultivated in sweet potatoes. The wheat was sown about October 20 and plowed in with a bull-tongue as soon as the potatoes were dug. Yield, 6 bushels per acre, of very poor quality, worth 75 cents per bushel.

Grown by Elliott T. Brady, Buffalo Forge, Rockbridge County, Virginia.

1851. *White Mediterranean.*

Crop of 1883; soil, heavy red clay. Land was first well plowed and harrowed twice with "Acme harrow," which thoroughly pulverized it. The seed was sown (3 quarts) with a drill, at the rate of 1½ bushels per acre and finally top-dressed with well-rotted stable manure at the rate of 15 loads per acre. No other cultivation. The land had previously been in wheat; yield, 5⅝ bushels from $\frac{1}{16}$ acre, or at the rate of 92 bushels per acre, weighing 64 pounds to the bushel. "This is a most *extraordinary* yield, but is *strictly true in every particular.*"

1852. *Australian.*

Crop of 1883. The origin of this specimen is unfortunately unknown.

Grown by John Q. Barker, Indian Wells, Summers County, West Virginia.

1853. *Osterey.*

Crop of 1883; soil, gravelly; no fertilizers; second year of cultivation; sown broadcast on corn stubble and plowed in with a bull-tongue; yield, 15 bushels per acre, weighing 62 pounds.

From the Northern Pacific Railroad, Washington Territory.

1854. *Wheat.*

Distributed to guests of the Northern Pacific Railroad at a banquet at Walla Walla, Washington Territory, October, 1883; crop of 1883.

From the Mills of Warder & Barnett, Springfield, Ohio.

1855. *Wheat.*
Used by the above firm for milling purposes. Crop of 1883.

From Morton & Co., Fargo, Dak.

Crop of 1883.

1861. *Hard Spring wheat.*
From the farm of L. S. Hurd, Cass County, Dakota. NE. ¼, 3, 138, 49. Yield, 24⅝ bushels per acre.

1862. *Hard Spring wheat.*
From the farm of C. A. Morton, Red River of the North, Cass County, Dakota. Yield, $26\frac{16}{60}$ bushels per acre.

1863. *Hard Spring wheat.*
From the farm of Terence Martin, Cass County, Dakota. S. 14, 141, 51. Yield, 25¼ bushels per acre.

1864. *Hard Spring wheat.*
From the farm of C. M. Palmer, Cass County, Dakota. Yield, 26½ bushels per acre.

1865. *Hard Spring wheat.*
From the farm of Morton & Co., Cass County, Dakota. S. 32, 142, 50. Yield, 27 bushels per acre.

1866. *Hard Spring wheat.*
From the farm of Hans Larson, Cass County, Dakota. S. 10, 141, 49. Yield, 27½ bushels per acre.

1867. *Hard Spring wheat.*
From the farm of Martin Erickson, Cass County, Dakota. SE. ¼, 11, 141, 49. Yield, 36 bushels per acre.

From Springer Harbaugh, Saint Paul, Minn.

1868. *Scotch Fife.*
From Keystone & Lockhardt farms, Polk County, Minnesota. Crop of 1883.

From Sykes & Hughes, Jamestown, Dak.

1869. *Hard Spring wheat.*
From the farm of D. F. Salisbury. S. 21, 134, 64. La Moure County, Dakota. Crop of 1883.

From C. A. Pillsbury & Co., Minneapolis, Minn.

2001. *Wheat No. 1, Spring.*
Used by the above firm for milling purposes. Crop of 1883.

2106. *Saskatchiwan, Scotch Fife.*
Crop of 1883.

2107. *Scotch Fife.*
Minneapolis No. 1, hard. Crop of 1883.

From H. W. Donaldson, Saint Paul, Minn.

2108. *Hard Spring wheat.*
Crop of 1883. Selected for seed.

2109. *Red Fife.*
Crop of 1883.

From Springer Harbaugh, Saint Paul, Minn.

2110. *Hard Spring wheat.*
From Pembina, Dak. Crop of 1883.

From R. Sykes & Hughes, Jamestown, Dak.

2111. *Hard Spring wheat.*
Grown in La Moure County, Dakota. Crop of 1883.

Grown by Pickering Dodge, Shenandoah Alum Springs, Shenandoah County, Virginia.

2112. *Osterey.*
Crop of 1883, from seed distributed by the Department.

2113. *Red Wheat.*
Crop of 1883, from seed described and analyzed in Bulletin No. 1, serial No. 782.

Grown by William Martin, Catawissa Depot, Pa.

2122. *Martin's Amber.*
Crop of 1883. Variety described in Pennsylvania Agricultural Report for 1882. Selected seed.

Grown by Prof. A. E. Blount, Fort Collins, Colorado; crop of 1883.

2123. *Eldorado*, collection No. 6. Previously analyzed as serial No. 728, crop of 1881.
2124. *Defiance*, collection No. 8.
2125. *Blount's Hybrid*, No. 9.
2126. *Blount's Hybrid*, No. 10.
Previously analyzed as serial No. 719, crop of 1881.
2127. *Oregon Club*, collection No. 10.
Previously analyzed as serial No. 735, crop of 1881.
2128. *White Mexican*, collection No. 13.
Previously analyzed as serial No. 729, crop of 1881.
2129. *Improved Fife*, collection No. 14.
Previously analyzed as serial No. 740, crop of 1881.
2130. *Russian*, collection No. 15.
Previously analyzed as serial No. 734, crop of 1881.
2131. *Blount's Hybrid*, No. 15.
Previously analyzed as serial No. 720, crop of 1881.
2132. *Blount's Hybrid*, No. 16.
Previously analyzed as serial No. 721, crop of 1881.
2133. *Sonora*, collection No. 12.
Previously analyzed as serial No. 739, crop of 1881.
2134. *Rio Grande*, collection No. 17.
Previously analyzed as serial No. 735, crop of 1881.
2135. *Blount's Hybrid*, No. 17.
Previously analyzed as serial No. 722, crop of 1881.
2136. *Blount's Hybrid*, No. 18.
Previously analyzed as serial No. 723, crop of 1881.
2137. *Judkin*, collection No. 19.
Previously analyzed as serial No. 730, crop of 1881.
2138. *Blount's Hybrid*, No. 19.
Previously analyzed as serial No. 724, crop of 1881.
2139. *Lost Nation*, collection No. 20.
Previously analyzed as serial No. 741, crop of 1881.
2140. *Blount's Hybrid*, No. 21.
Previously analzyed as serial No. 725, crop of 1881.
2141. *Touselle*, collection No. 21.
Previously analyzed as serial No. 736, crop of 1881.
2142. *Australian Club.*
Previously analyzed as serial No. 731, crop of 1881.
2143. *Blount's Hybrid*, No. 23. Hybrid of two years' standing.
2144. *Blount's Hybrid*, No. 24. " " " " "
2145. *Blount's Hybrid*, No. 25. " " " " "
2146. *Blount's Hybrid*, No. 26. " " " " "
2147. *Blount's Hybrid*, No. 27. " " " " "
2148. *Blount's Hybrid*, No. 28. " " " " "

2149. *Blount's Hybrid*, No. 29. Hybrid of two years' standing.
2150. *Blount's Hybrid*, No. 30. " " " " "
2151. *Blount's Hybrid*, No. 31. " " " " "
2152. *Blount's Hybrid*, No. 33. " " " " "
2153. *Pringle's Hybrid*, No. 6, collection No. 33.
Previously analyzed as serial No. 743, crop of 1881.
2154. *Pringle's Hybrid*, No 7, collection No. 34.
2155. *Blount's Hybrid*, No. 34.
Two years old.
2156. *Blount's Hybrid*, No. 35. Hybrid of two years' standing.
2157. *Blount's Hybrid*, No. 36. " " " " "
2158. *Blount's Hybrid*, No. 37. " " " " "
2159. *Black Bearded Centennial*, collection No. 40.
Previously analyzed as serial No. 727, crop of 1881.
2160. *Hedge Row, White Chaff*, collection No. 41.
Previously analyzed as serial No. 745, crop of 1881.
2161. *Hedge Row, Red Chaff*, collection No. 69.
Previously analyzed as serial No. 746, crop of 1881.
2162. *Fountain*, collection No. 71.
Previously analyzed as serial No. 732, crop of 1881.
2163. *White Chaff*, collection No. 74.
Previously analyzed as serial No. 747, crop of 1881.
2164. *Perfection*, collection No. 76.
Previously analyzed as serial No. 733, crop of 1881.
2165. *Triticum*, collection No. 79.
Previously analyzed as serial No. 748, crop of 1881.
2166. *Russian Durum*, collection No. 81.
Previously analyzed as serial No. 749, crop of 1881.
2167. *Meekin's*, collection No. 88.
Previously analyzed as serial No. 751, crop of 1881.
2168. *German Fife*, collection No. 77.
Previously analyzed as serial No. 737, crop of 1881.
2169. *Prossoc*, collection No. 110.
From California, third crop in Colorado, 1883.
2170. *Prossoc*, collection No. 110.
Second crop in Colorado, 1882.
2171. *Winnipeg Russian*, collection No. 149.
One year old, in Colorado, 1882.
2172. *Winnipeg Russian*, collection No. 149.
Second year's crop in Colorado.
2173. *White Mediterranean*.
Seed received from the Department of Agriculture in 1882.
2174. *White Mediterranean*, collection No. 173.
Product from preceding seed, changed from a winter to a spring wheat. "It will be better next year."
2175. *Red Mediterranean*.
Seed received from the Department of Agriculture in 1882.
2176. *Red Mediterranean*, collection No. 174.
Product from preceding seed.
2177. *French Imperial*.
A spring wheat, distributed by the Department of Agriculture in 1882.
2178. *French Imperial*, collection No. 175.
Product from preceding seed.
2179. *Rust Proof*.
A winter wheat from North Carolina, furnished to Professor Blount.

2180. *Rust Proof*, collection No. 179.
Product from preceding seed, turned to spring.
2181. *Purple Straw.*
A winter wheat from North Carolina.
2182. *Purple Straw*, collection No. 182.
Product of the preceding seed turned to spring.
2183. *Golden Premium.*
A winter wheat from North Carolina "badly mixed."
2184. *Golden Premium*, collection No. 183.
Product from preceding seed. Winter variety changed to spring.
2185. *Hick's Prolific.*
A winter wheat from North Carolina.
2186. *Hick's Prolific*, collection No. 184.
Product from preceding seed. A winter variety changed to spring. "It refused to turn completely, and will require another year."
2187. *Geiger.*
A spring wheat from Northern Asia.
2188. *Geiger*, collection No. 192.
Product from preceding seed.
2189. *Blount's Hybrid*, No. 13.

Grown by W. Brotherton, superintendent of the Ohio Agricultural Experiment Station Farm, Columbus, Ohio, crop of 1883.

2701. *Royal Australian.*
2702. *Treadwell.*
2703. *Champion Amber.*
2704. *McPherson.*
2705. *Clawson.*
2706. *Bearded Treadwell.*
2707. *Valley.*
2708. *Pool.*
2709. *Landreth.*
2710. *Theiss.*
2711. *Michigan Amber.*
2712. *Finley.*
2713. *Zimmerman.*
2714. *Golden Drop.*
2715. *Rocky Mountain.*
2716. *Travis.*
2717. *McGeehee's White.*
2718. *White Velvet.*
2719. *Russian May.*
2720. *Nigger.*
2721. *Wayne's Select.*
2722. *Bennett.*
2723. *Silver Chaff.*
2724. *McGeehee's Red.*
2725. *Lancaster.*
2726. *Rodger's.*
2727. *Red Fultz.*
2728. *Tasmanian.*
2729. *Michigan Bronze.*
2730. *Golden Straw.*
2731. *Velvet Chaff.*
2732. *German Amber.*
2733. *Democrat.*

2734. *York White Chaff.*
2735. *Rice.*
2736. *Mediterranean.*
2737. *Martin's Amber.*
2738. *Fultz.*
2739. *Heighes' Prolific.*
2740. *Grecian.*
2741. *Egyptian.*
2742. *Sandomirka.*

From Centennial Exposition, 1876. Specimens in Department Museum grown in California.

2743. *Propo.*
Sperry & Co., San Joaquin County.
2744. *Sonora.*
George Klymer, San Joaquin County.
2745. *Nonpareil.*
William G. Phelps, San Joaquin County.
2746. *Pride of Butte.*
Sperry & Co., San Joaquin County.
2747. *Nonpareil.*
Andrew Wolf, San Joaquin County.
2748. *White Chili.*
Farmers' Union, San Joaquin County.
2749. *White Australian.*
J. Stranzer, San Joaquin County.
2750. *Jones.*
J. Stranzer, San Joaquin County.

Grown in Colorado.

2751. *White Chili.*
W. G. Fowler, Fremont County.
2752. *Colorado Red Chaff.*
W. G. Fowler, Fremont County.

Grown in California.

2753. *Fultz.*
J. Arnold, El Paso County.
2754. *White Colorado.*
R. Gaines, El Paso County.

From Utah.

2756. *Taos.*
Originally from Taos Valley, New Mexico. Grown by C. C. Snow, Hyrum City, Cache County. Crop of 1882.
2757. *Red Taos.*
Grown by Thomas Ord, Nephi, Utah. Crop of 1875.
2758. *Leran.*
Grown by J. W. Shepard, Juab County, 45 bushels to the acre; harvested July 26, 1872.

From Washington Territory.

2759. *Tappahannock.*
Grown by C. B. McFaden, Lewis County, 1871; 62 bushels per acre.

From New Mexico.

2760. *Wheat.*
Raised by Indians in the Taos Valley. From Department of Agriculture Museum.

EXPLANATION OF THE ANALYSES.

In the previous bulletin the analyses included determinations of water, ash, oil, fiber, and albuminoids. During the past year the determinations of oil and fiber have been omitted, as the slight variations which have been found to occur are of less importance in the consideration of the value of the grain, and as the data already obtained are quite sufficient for this purpose. The determination of the albuminoids in connection with the size and condition of the wheat settle, as far as a chemical and physical examination can succeed, the peculiarities of the samples in hand.

THE RESULTS.

The results are presented in the following tables, arranged in the same manner as in previous reports. There is also a table giving such analyses of wheats from other sources as were not included in the previous bulletin.

Serial number.	Name.	Form.	Color.	Consistency.	Year of growth.	Weight of 100 grains.	Water.	Ash.	Undetermined.	Albuminoids.	Nitrogen.
	PENNSYLVANIA.										
						Grams.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
2122	Martin's Amber	Fine	White	Hard	1883		11.30	2.03	73.54	13.13	2.10
	VIRGINIA.										
1851	White Mediterranean	Good	White	Soft	1883	4.255	7.73	2.32	78.92	11.03	1.76
2089	Fultz and Longberry	Fine			1883		9.62	1.93	75.67	12.78	2.04
2112	Osterey	Fair	Yellow	Hard	1883	3.565	9.22	2.50	75.68	12.60	2.02
2113	Red	do	Red	Medium	1883	3.465	9.33	2.15	77.32	11.20	1.79
	WEST VIRGINIA.										
1846	Early Amber	Fair	Amber	Soft	1883		9.42	2.00	77.73	10.85	1.74
1853	Osterey	do	Yellow	Medium	1883	3.392	7.68	2.13	79.16	11.03	1.76
	ALABAMA.										
1847	Dallas	Fair	Yellow	Hard	1882	4.447	9.29	1.79	77.72	11.20	1.79
1848	do	do	do	do	1883	4.277	10.31	1.69	77.67	10.33	1.65
	OHIO.										
2701	Royal Australian	Fair	White	Soft	1883	4.092	10.53	1.80	76.99	10.68	1.71
2702	Treadwell	do	Amber	Medium	1883	3.467	11.16	1.97	75.14	11.73	1.88
2703	Champion Amber	do	do	do	1883	3.268	12.31	2.03	74.46	11.20	1.79
2704	McPherson	do	do	do	1883	3.503	10.65	2.00	75.62	11.73	1.88
2705	Clawson	do	Yellow	Soft	1883	3.300	10.54	1.93	73.70	13.83	2.21
2706	Treadwell, boarded	do	do	do	1883	3.590	9.74	2.30	75.18	12.78	2.04
2707	Valley	do	Amber	Medium	1883	3.250	12.49	1.55	74.06	11.90	1.90
2708	Pool	do	Red	Hard	1883	3.500	10.60	1.90	75.42	12.08	1.93
2709	Landreth	do	White	Soft	1883	3.900	11.82	1.73	75.25	11.20	1.79
2710	Theiss	Shriv'l'd	Red	Hard	1883	2.988	10.95	2.00	73.22	13.83	2.21
2711	Michigan Amber	Fair	Light Red	do	1883	5.800	10.42	2.06	75.79	11.73	1.88
2712	Finley	do	Amber	Medium	1883	3.587	10.00	1.96	74.04	14.00	2.24
2713	Zimmerman	Shriv'l'd	do	do	1883	3.328	11.39	2.04	73.44	13.13	2.10
2714	Golden Drop	Fair	do	do	1883	3.555	11.86	1.74	74.32	12.08	1.93
2715	Rocky Mountains	do	do	do	1883	3.055	9.56	1.77	75.37	13.30	2.13
2716	Travis	Plump	Light Amber	Soft	1883	2.987	10.66	2.20	74.89	12.25	1.99
2717	McGehee's White	Mixed	White	do	1883	3.225	10.68	1.75	74.97	12.60	2.02
2718	White Velvet	do	Amber	do	1883	2.780	10.60	2.06	75.44	11.90	1.90
2719	Russian	do	do	Medium	1883	2.644	9.87	2.09	73.34	14.70	2.35
2720	Nigger	Plump	Red	Hard	1883	4.162	10.67	1.81	76.14	11.38	1.82
2721	Wayne's Select	Mixed	Yellow	Soft	1883	2.663	10.73	1.75	74.22	13.30	2.13

ANALYSES OF AMERICAN WHEATS, ARRANGED BY STATES—CONTINUED.

Serial number.	Name.	Form.	Color.	Consisteney.	Year of growth.	Weight of 100 grains.	Water.	Ash.	Undetermined.	Albuminoids.	Nitrogen.
	OHIO—continued.					*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
2722	Bennett	Fair	Yellow	Soft	1883	2.885	10.69	1.81	74.55	12.95	2.07
2723	Silver Chaff	do	do	do	1883	3.270	10.11	1.87	76.29	11.73	1.88
2724	McGehee's Red	do	Amber	Medium	1883	3.288	9.76	1.87	74.02	14.35	2.30
2725	Lancaster	do	Light Red	Hard	1883	3.887	9.90	2.15	72.90	15.05	2.41
2726	Rogers	do	Amber	do	1883	3.108	9.48	1.65	75.39	13.48	2.16
2727	Red Fultz	do	Red	do	1883	3.290	11.32	2.05	73.33	13.30	2.13
2728	Tasmanian	do	do	do	1883	3.581	10.60	2.05	73.70	13.65	2.18
2729	Michigan Bronze	do	do	do	1883	4.093	10.58	1.89	76.85	10.68	1.71
2730	Golden Straw	do	Amber	Medium	1883	3.759	10.30	2.00	74.22	13.48	2.16
2731	Velvet Chaff	do	Red	Hard	1883	3.983	10.16	2.10	72.51	15.23	2.44
2732	German Amber	do	do	do	1883	3.765	9.75	2.02	73.53	14.70	2.35
2733	Democrat	Plump	White	Soft	1883	3.317	10.03	2.14	75.75	12.08	1.93
2734	York White Chaff	Mixed	Yellow	do	1883	3.105	11.45	1.90	74.57	12.08	1.93
2735	Rice	do	Amber	Medium	1883	3.393	11.36	2.09	72.37	14.18	2.27
2736	Mediterranean	Plump	do	Hard	1883	3.940	11.13	2.13	70.64	16.10	2.58
2737	Martin's Amber	Fair	White	do	1883	3.342	11.32	2.03	74.40	12.25	1.96
2738	Fultz	do	Light Red	do	1883	3.505	11.37	2.00	73.50	13.13	2.10
2739	Heighes' Prolific	Plump	do	do	1883	3.378	10.05	1.79	74.68	13.48	2.16
2740	Grecian	Mixed	Yellow	Medium	1883	3.312	10.95	1.86	75.99	11.20	1.79
2741	Egyptian	Fair	Amber	do	1883	3.565	11.98	1.76	73.31	12.95	2.07
2742	Sandomirka	do	Light Red	Hard	1883	2.905	11.76	1.88	72.53	13.83	2.21
	ILLINOIS.										
1855		Plump			1883		9.05	2.06	76.46	12.43	1.99
	TENNESSEE.										
1850		Fair	Red	Soft	1883		10.92	2.32	74.51	12.25	1.96
	ARKANSAS.										
1849	Mediterranean	Fair	Red	Soft	1883		9.56	2.52	74.97	12.95	2.07
	MINNESOTA.										
2001	C. A. Pillsbury Mill	Plump	Red	Hard	1883	2.720	9.56	1.91	74.35	14.18	2.27
1868	Polk County	Medium	do	do	1883	2.780	8.31	2.05	75.29	14.35	2.30
2107	Minnesota Hard, No. 1	Plump	do	do	1883	2.926	8.05	1.93	76.19	13.83	2.21
2108	Minnesota Hard, No. 1	Fine	do	do	1883	3.577	8.11	1.76	74.90	15.23	2.44

	DAKOTA.										
1861	Cass County	Plump	do	do	1883	2.841	8.89	1.89	73.12	16.10	2.58
1862	Cass County	do	do	do	1883	2.771	7.71	1.95	74.24	16.10	2.58
1863	Cass County	do	do	do	1883	3.312	7.67	2.10	75.70	14.53	2.32
1864	Cass County	do	do	do	1883	2.802	7.73	1.91	75.13	15.23	2.44
1865	Cass County	do	do	do	1883	3.368	8.48	1.76	72.43	17.33	2.77
1866	Cass County	do	do	do	1883	3.389	8.47	1.96	75.57	14.00	2.24
1867	Cass County	do	do	do	1883	2.921	8.56	2.07	75.02	14.35	2.30
1869	La Moure County	do	do	do	1883	3.700	8.07	1.99	73.66	16.28	2.60
2111	La Moure County	do	do	do	1883	3.074	9.57	1.89	70.51	18.03	2.88
2110	Pembina	do	do	do	1883	3.335	9.92	1.84	75.81	12.43	1.99
	PROVINCES.										
2106	Saskatchiwan	Plump	Red	Hard	1883	3.111	8.85	1.92	73.65	15.58	2.49
2109	Manitoba	do	do	do	1883	3.465	7.84	1.33	77.35	13.48	2.16
	COLORADO.										
2751	White Chili	Plump	Yellow	Soft		3.500	8.23	1.99	79.98	9.80	1.57
2752	Colorado Red Chaff	do	Yellow Amber	Medium		3.478	9.16	2.01	79.03	9.80	1.57
2123	No. 6 Eldorado	do	Yellow	Hard	1883	4.223	9.53	1.95	78.72	9.80	1.57
2124	C No. 8, Defiance	do	do	Soft	1883	3.774	9.79	1.74	77.79	10.68	1.71
2125	Blount's No. 9	do	do	do	1883	4.503	9.53	1.97	78.00	10.50	1.68
2126	Blount's No. 10	do	do	Medium	1883	5.024	8.68	2.26	78.03	11.03	1.76
2127	Collection No. 10, Oregon Club	do	do	Hard	1883	3.714	8.75	2.10	77.77	11.38	1.82
2128	Collection No. 13, White Mexican	do	do	Soft	1883	4.442	8.35	2.20	77.55	11.90	1.90
2129	Collection No. 14, Improved Fife	do	Amber	Hard	1883	3.784	9.28	2.04	74.85	13.83	2.21
2130	Collection No. 15, Russian	do	Red	do	1883	3.808	8.15	2.07	77.53	12.25	1.96
2189	Blount's No. 13	do	do	do	1883	3.699	10.27	2.16	76.89	10.68	1.71
2131	Blount's No. 15	do	do	V. hard	1883	3.572	8.87	2.03	77.37	11.73	1.88
2132	Blount's No. 16	do	Amber	Hard	1883	5.036	8.70	2.13	78.14	11.03	1.76
2133	Sonora collection No. 12	do	Yellow	Soft	1883	3.618	9.12	1.96	76.14	12.78	2.04
2134	Rio Grande collection No. 17	do	Red	Medium	1883	4.162	8.89	2.03	76.13	12.95	2.07
2135	Blount's No. 17	do	do	Hard	1883	4.818	8.90	2.23	74.52	14.35	2.30
2136	Blount's No. 18	do	Amber	do	1883	3.351	9.16	2.10	77.71	11.03	1.76
2137	Collection No. 19, Judkin	do	do	Medium	1883	3.761	9.13	1.91	77.41	11.55	1.85
2138	Blount's No. 19	do	Yellow	Soft	1883	3.442	9.47	1.96	78.59	9.98	1.60
2139	Collection No. 20, Lost Nation	do	Amber	Hard	1883	3.739	9.93	1.87	76.65	11.55	1.85
2140	Blount's No. 21	do	do	Soft	1883	3.543	9.51	1.89	77.75	10.85	1.74
2141	Collection No. 21, Tousello	do	Yellow	Hard	1883	4.247	10.73	2.12	73.85	13.36	2.13
2142	Collection No. 22, Australian Club	do	do	Medium	1883	4.425	8.97	1.97	78.03	11.03	1.76
2143	Blount's No. 23	do	do	Soft	1883	3.942	9.69	2.31	78.10	10.50	1.68
2144	Blount's No. 24	do	do	do	1883	3.004	9.58	2.07	78.55	9.80	1.57
2145	Blount's No. 25	do	do	Medium	1883	3.873	9.30	2.14	77.71	10.85	1.74
2146	Blount's No. 26	do	do	do	1883	3.987	9.40	2.20	74.02	14.38	2.38
2147	Blount's No. 27	do	do	do	1883	2.645	9.46	1.98	79.63	8.93	1.43
2148	Blount's No. 28	do	do	do	1883	3.827	9.32	2.28	78.42	9.98	1.60
2149	Blount's No. 29	do	do	Hard	1883	2.998	9.33	1.91	79.66	9.10	1.46
2150	Blount's No. 30	do	do	Medium	1883	2.897	9.70	1.81	79.21	9.28	1.48
2151	Blount's No. 31	do	do	do	1883	3.321	10.40	2.19	78.31	9.10	1.46

ANALYSES OF AMERICAN WHEATS, ARRANGED BY STATES—CONTINUED.

Serial number.	Name.	Form.	Color.	Consistency.	Year of growth.	Weight of 100 grains.	Water.	Ash.	Undetermined.	Albuminoids.	Nitrogen.
	COLORADO—continued.					*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
2152	Blount's No. 33	Plump	Yellow	Hard	1883	2.716	10.15	1.87	79.05	8.93	1.43
2153	Pringle No. 6	do	do	do	1883	4.651	9.30	2.08	74.97	13.65	2.18
2154	Pringle No. 7	do	do	Soft	1883	3.968	9.15	2.05	76.72	12.08	1.93
2155	Blount's No. 34	do	Amber	V.hard, glassy	1883	5.179	8.82	2.43	76.15	12.60	2.02
2156	Blount's No. 35	do	Yellow	Soft	1883	3.055	9.37	2.27	77.86	10.50	1.68
2157	Blount's No. 36	do	Amber	Hard	1883	3.224	9.08	2.00	78.24	10.68	1.71
2158	Blount's No. 37	do	Yellow	Medium	1883	3.559	10.72	2.44	74.94	11.90	1.90
2159	Black Bearded Centennial, Collection No. 40	do	do	Hard	1883	5.578	8.60	2.10	77.45	11.85	1.85
2160	Collection No. 41, Hedge Row, White Chaff	do	do	Soft	1883	2.838	9.16	2.02	77.09	11.73	1.88
2161	Collection No. 69, Hedge Row, Red Chaff	do	do	Medium	1883	4.008	9.18	2.19	75.68	12.95	2.07
2162	Collection No. 71, Fountain	do	do	Soft	1883	4.191	8.27	2.14	77.69	11.90	1.90
2163	Collection No. 74, White Chaff	do	Red	Hard	1883	3.252	7.95	2.05	77.92	12.08	1.93
2164	Collection No. 76, Perfection	do	Yellow	do	1883	5.032	10.29	2.08	74.68	12.95	2.07
2165	Collection No. 79, Traticum	do	do	do	1883	4.861	8.98	2.02	75.00	14.00	2.24
2166	Collection No. 81, Russian Durum	do	do	Medium	1883	4.761	8.70	2.10	74.85	14.35	2.30
2167	Collection No. 88, Mukin's	do	Red	do	1883	4.414	10.15	2.05	74.32	13.48	2.16
2168	Collection No. 77, German Fife	do	Amber	Soft	1883	4.546	10.05	2.28	75.07	12.60	2.02
2169	Collection No. 110, Product of 1883, Prossoe, three years old.	do	Yellow	do	1883	4.275	8.85	2.38	75.47	13.30	2.13
2170	Collection No. 110, Product of 1882, Prossoe, three years old.	do	do	do	1882	4.654	9.62	2.52	75.78	12.08	1.93
2171	Collection No. 149, product of 1882, winter	do	Amber	Medium	1882	3.438	8.92	2.31	75.99	12.78	2.04
2172	Collection No. 149, product of 1883, winter, two years old.	do	do	Soft	1883	3.985	9.68	2.14	75.93	12.25	1.96
2174	Collection No. 173, White Mediterranean, product to spring, 1883.	do	Yellow	do	1883	4.182	9.69	2.19	76.92	11.20	1.79
2176	Collection No. 174, Red Mediterranean, product to spring, 1883.	do	Amber	V. hard	1883	3.650	9.50	2.10	74.75	13.65	2.18
2178	Collection No. 175, French Imperial, winter to spring, 1883.	do	do	Medium	1883	4.594	9.55	1.95	75.55	12.95	2.07
2180	Collection No. 179, Rust Proof, product to spring, 1883.	do	do	Soft	1883	4.957	10.25	2.10	75.22	12.43	1.99
2182	Collection No. 182, Purple Straw, product winter to spring.	do	do	do	1883	3.231	11.11	2.04	74.25	12.60	2.02
2184	Collection No. 183, Golden Premium, product winter to spring.	do	Yellow	Medium	1883	3.818	9.44	2.17	77.01	11.38	1.82
2186	Collection No. 184, Hick's Prolific product	do	Amber	Soft	1883	2.879	9.21	2.04	78.42	10.33	1.65
2188	Collection No. 192, Geiger product	do	Yellow	Medium	1883	4.064	9.92	2.20	73.35	14.53	2.32
	UTAH.										
2757	Red Taos	Fair	Yellow	Soft	1875	4.084	9.27	1.93	78.30	10.50	1.68
2758	Loran	do	do	do	1875	3.703	9.07	2.53	D 78.60	9.80	1.57

	NEW MEXICO.									
2756	Taos	Fair	Yellow	Soft	1882	3 188	9.50	2.10	76.67	11.73	1.88
2760	German	do	do		1875	3.956	9.10	1.77	79.85	9.28	1.47
2743	Propo	Good	do	Soft	1875	3.616	11.37	1.87	74.68	12.08	1.93
2744	Sonora	do	do	do	1875	3.320	11.40	2.02	76.43	10.15	1.62
2745	Nonpareil	do	do	do	1875	5.184	11.82	1.79	75.19	11.20	1.79
2746	Pride of Butte	do	do	do	1875	3.445	11.18	1.90	76.94	9.98	1.60
2747	Nonpareil	do	do	do	1875	3.905	10.82	1.93	74.47	12.78	2.04
2748	White Chili	do	do	do	1875	4.163	10.47	1.95	75.68	11.90	1.90
2749	White Australian	do	do	do	1875	5.042	10.38	2.02	78.50	9.10	1.46
2750	Jones	do	do	do	1875	3.611	10.16	1.68	78.71	9.45	1.51
2753	Fultz	do	Red	Hard	1875	3.095	10.20	1.49	76.06	12.25	1.96
2754	White Colorado	do	Yellow	Soft	1875	3.543	9.53	1.97	78.00	10.50	1.68
	WASHINGTON TERRITORY.									
1854	Walla Walla	Fine	White	Soft	1883	2.584	10.13	1.95	80.22	7.70	1.23
2759	Tappahanock	do	Yellow	Glossy	1871	4.726	9.65	2.02	79.58	8.75	1.40

CONCLUSIONS DERIVED FROM THE DATA.

The analyses in the preceding tables when combined with those previously published modify to a certain immaterial degree the average composition of the wheat of the whole country. The few scattered analyses from the Eastern States change the averages for those States very slightly, the greater number of specimens coming from Ohio, Minnesota, Dakota, and California, localities which were not represented before, or at most indifferently well; and from Colorado, where wheats from the same farm have been examined for three consecutive years.

OHIO.

The wheats from this State were grown on the farm of the Ohio State University, near Columbus, Ohio. A number of them were the result of experiments on the yield and other qualities of the grain, which have been carried on by the farm superintendent, Mr. W. Brotherton, for three years.

The crop of 1883 averaged, it is said, about 30 bushels per acre. It was not, however, entirely plump, "owing to a wet spring succeeded by dry weather before ripening," and the weight per bushel was therefore light, about 57 pounds. The fact that the grain was shriveled was very likely due to a lack of ability to fill the floury portion with its full quantity of starch, and the relative percentage of nitrogen is therefore higher than would be found in a well-developed grain.

From the data derived from the experiments above mentioned, the following averages have been published by Mr. Brotherton:

Average yield per acre, crop of 1883.

Grain	bushels..	39.33
Straw	pounds..	4727.
Pounds straw to bushel of wheat		120.1
Weight of wheat per bushel	pounds..	56.6

Average yield and weight of red wheat, compared with white wheat.

	Average yield.			Average weight.		
	1881.	1882.	1883.	1881.*	1882.*	1883.†
	Bushels.	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*
Red	21.6	24.1	38.9	60.1	57.9	57.5
White	20.8	24.6	35.5	60.0	59.5	55.6

Average yield and weight of smooth wheat, compared with bearded wheat.

	Average yield.			Average weight.		
	1881.	1882.	1883.	1881.*	1882.*	1883.†
	Bushels.	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*
Smooth	20.2	23.5	37.6	59.7	59.2	56.9
Bearded	22.5	24.6	42.7	60.7	59.5	57.4

* As cleaned for seed. † As from machine.

The red varieties and the bearded wheats seem to possess a trifling advantage in Ohio, at least for the years during which the experiments were carried on.

MINNESOTA.

The specimens previously analyzed from this State were from the exhibits of the Saint Paul, Minneapolis and Manitoba Railroad in the Department Museum, but as they were not considered representative wheats by prominent millers, and the results were unsatisfactory to them, they were invited to send samples of their own selection from the crop of 1883. The analyses given in this bulletin will, therefore, show the composition of the best spring wheat of Minnesota, but it can hardly be said to represent the average of the State, as the samples were all of No. 1 hard wheat.

The average of the analyses previously published, of the four made this year and of all taken together, are given below:

	Railroad exhibits, &c.	No. 1 hard wheat, 1883.	All.
Number of analyses	9.	4.	13.
Weight of 100 grains.....grams..	3.354	3.001	3.168
Water.....per cent..	10.60	8.64	9.96
Ash.....do....	1.71	1.91	1.77
Undetermined.....do...	75.03	75.05	75.09
Albuminoids.....do....	12.66	14.40	13.18
	100.00	100.00	100.00
Nitrogen.....do.....	2.03	2.31	2.11

The average of all probably fairly represents the production of the State, while "No. 1 hard spring wheat" is richer in albuminoids, but small in size, both of which characteristics may be due to a lack of starch, owing to the short period of growth and rapid maturity and consequent inability to assimilate as much of the carbohydrates as the winter wheats.

This point is well illustrated by two wheats from Dakota, analyses of which were published in our previous report, one of which was a winter wheat and the other spring. The weights of one hundred grains were—

	Grams.
Winter	3.513
Spring	2.755

and the percentages of albuminoids—

Winter	10.68
Spring	14.35

the latter being in inverse proportion to the former, so that if the winter wheat were supposed to be diminished in size at the expense of its starch the relative percentage of nitrogen would rise to a point near that usually found in spring wheats.

In another portion of this report the flours and mill products from the spring wheats of Minnesota will be discussed.

DAKOTA.

The only two specimens of Dakota wheat which have hitherto been analyzed are those of which mention has just been made.

Through the kindness of General M. V. Z. Woodhull, specimens of the crop of spring wheat of 1883 from some of the leading farms of the Territory have been sent to this Division. As will be seen, they are all extremely rich in albuminoids with the exception of that grown in Pembina. One specimen contains 18.03 per cent. of albuminoids, and the ten together average over 15 per cent.

Average composition of Dakota spring wheat, crop of 1883.

Weight of 100 grains	grams..	3.151
Water	per cent..	8.51
Ash	do....	1.94
Undetermined	do....	74.11
Albuminoids	do....	15.44
		100.00
Nitrogen	do....	2.47

The wheat containing 18.03 per cent. of albuminoids is the richest which has yet been analyzed in the United States. It was grown in Lamoure County by Sykes & Hughes; and is, of course, a spring variety. It would be interesting to observe the composition of a winter wheat grown on that soil, the only winter specimen which has been analyzed having, as has been said, a small percentage of albuminoids

With the modern methods of milling, hard wheats of the description which have been analyzed are very desirable, and Dakota and Minnesota with their large supplies of grain, rich in nitrogenous constituents, will necessarily produce some of the finest flours in the country, more nearly approaching the Hungarian than any other.

COLORADO.

In the previous bulletin the analyses were published of a large number of wheats from Colorado, grown during the years 1881 and 1882 by Prof. A. E. Blount, of the agricultural college, at Fort Collins.

The average composition for each year was as follows:

Average composition of Colorado wheat, crops of 1881 *and* 1882.

		1881.	1882.
Number of varieties analyzed		33	12
Weight of 100 grains	grams..	4.865	4.283
Water	per cent..	9.86	8.80
Ash	do....	2.28	1.99
Oil	do....	2.41	2.38
Carbhydrates	do....	70.48	72.08
Crude fiber	do....	1.57	1.76
Albuminoids	do....	13.40	13.04
		100.00	100.00
Nitrogen	do....	2.14	2.09

Or for the two seasons:

Average composition of Colorado wheats for the two seasons, 1881–'82.

Number of varieties analyzed		45
Weight of 100 grains	grams..	4.682
Water	per cent..	9.57
Ash	do....	2.21
Oil	do....	2.38
Carbhydrates	do....	70.91
Crude fiber	do....	1.62
Albuminoids	do....	13.31
		100.00
Nitrogen	do....	2.13

Specimens of the crop of 1883 have been examined, and the average for that year obtained.

Average composition of Colorado wheat, crop of 1883.

Number of varieties analyzed		57
Weight of 100 grains	grams..	3.941
Water	per cent..	9.38
Ash	do....	2.09
Undetermined	do....	76.79
Albuminoids	do....	11.74
		100.00
Nitrogen	do....	1.88

It is plain that there has been a very marked falling off in albuminoids. Twenty-eight of the fifty-seven varieties examined this year were also among the specimens of 1881. The averages for the two years of the same varieties show in the same way changes such as were seen in the average of all.

Average composition of twenty-seven Colorado wheats in 1881 and in 1883.

		1881.	1883.
Weight of 100 grains	grams..	4.947	4.197
Water	per cent..	9.83	9.15
Ash	do....	2.23	2.00
Undetermined	do....	74.52	76.66
Albuminoids	do....	13.42	12.19
		100.00	100.00
Nitrogen	do....	2.15	1.95

There has been a falling off in ash and albuminoids, and in the weight of 100 grains, and the uniformity of the change in these respects is shown by a comparison of each analysis in this regard.

Comparison of the crops of 1881 *and* 1883.

Serial number.	Weight of 100 grains.		Water.		Ash.		Albuminoids.		Nitrogen.	
	1881.	1883.	1881.	1883.	1881.	1883.	1881.	1883.	1881.	1883.
	Grams.	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
728	4.702		10.55		2.24		11.75		1.88	
2123		4.223		9.53		1.95		9.80		1.57
719			9.72		2.28		13.75		2.20	
2126		5.024		8.68		2.26		11.03		1.76
738	4.434		9.59		1.91		12.25		1.96	
2127		3.714		8.75		2.10		11.38		1.82
729			9.91		2.60		13.81		2.21	
2128		4.442		8.35		2.20		11.90		1.90
734	4.131		9.55		1.99		14.49		2 31	
2130		3.808		8.15		2 07		12.25		1.96
720			10.07		1.03		12.25		1.96	
2131		3.572		8.87		2.03		11.73		1.88
721	4.824		9.53		2.04		11.75		1.88	
2132		5.036		8.70		2.13		11.03		1.76
739	4.739		10.17		2 02		14.18		2.27	
2133		3.618		9.12		1.96		12.78		2.04
735	5.906		9.51		2.08		14.69		2.35	
2134		4.162		8.89		2.03		12.95		2.07
722	5.137		9.93		2.07		13.62		2.18	
2135		4.818		8.90		2.23		14.35		2.30
723			9.74		2.19		12.94		2.07	
2136		3.351		9.16		2.10		11.03		1.76
730			9.75		2.57		12.25		1.96	
2137		3.761		9.73		1.91		11.55		1.87
724			10.55		2.54		12.44		1.99	
2138		3.442		9.47		1.96		9.98		1.60
741	3.851		10.24		2.17		12.93		2.07	
2139		3.739		9.93		1.87		11.55		1.85
736	5.214		10.25		2.10		13 50		2.16	
2141		4.247		10.73		2.12		13.30		2.13
731	5.506		9.78		1.85		11.19		1.79	
2142		4.425		8.97		1.97		11.03		1.76
742	5.145		9.89		2.13		13 13		2.10	
2153		4.651		9.30		2.08		13.65		2.18
743	4.636		9.89		2.23		15.25		2.44	
2154		3.968		9.15		2.05		12.08		1.93
727			9.66		2.35		12.06		1.93	
2159		5.578		8.60		2.10		11.85		1.85
745	4.072		9.07		2.08		13.62		2.18	
2160		2.838		9.16		2.02		11.73		1.88
746	4.499		9.17		2.59		12.94		2.07	
2161		4.208		9.18		2.19		12.95		2.07
732	5.100		10.58		2.70		13.62		2.18	
2162		4.191		8.27		2.14		11.90		1.90
747	4.214		9.57		2.03		14.04		2.25	
2163		3.252		7.95		2.05		12.08		1.93
733	5.536		9.93		1.99		14.18		2.27	
2164		5.032		10.29		2.08		12.95		2.07
748	5.754		10.02		2.67		13.62		2 18	
2165		4.861		8.98		2.02		14.00		2.24
749	5.924		9.91		2.32		15.25		2.44	
2166		4.761		8.70		2.10		14.35		2.30
751	5.193		9.38		2.53		15.15		2.43	
2167		4.414		10.15		2.05		13.48		2.16
737	5.368		10.42		2.31		15.06		2.41	
2168		4.546		10.05		2.28		12.60		2.02

There was a loss of albuminoids in every variety, with four exceptions, and a decrease in weight in all but one. This change, which at first seemed rather surprising, is explained by Professor Blount in the following letter:

COLORADO AGRICULTURAL COLLEGE,
Fort Collins, Colo., June 17, 1884.

MY DEAR SIR: Your letter of the 11th, inclosing analyses of wheats, received. I am not at all surprised at the falling off in the albuminoids and other deleterious changes. I think I can give a satisfactory reason for the deterioration.

First. In June of last year, while these wheats were in the formation stage, we had a heavy and destructive hail-storm, which almost entirely destroyed my whole crop. So badly was it beaten down that it was a month before the crop was where it was before, and not half of it then was making anything like good grain. I find when the wheat plant is in any way injured the grain especially suffers most. The foliage, if anything, rather flourishes, or, in other words, grows more vigorously and rank. The sap is more abundant, and the grain producing elements much less.

Second. Last year up to August we had much more rain than ever before. Frequent showers, followed by hot suns and damp, sultry air, made many of my wheats rust. Those injured and put back by hail suffered most from rust.

I am satisfied these are the causes of deterioration noticed in the analyses. The difference in the two seasons was as great as that between ours generally and that of Iowa. I think this year will bring out my hybrids with a better showing.

Very truly, yours,

A. E. BLOUNT.

CLIFFORD RICHARDSON, Esq.,
Assistant Chemist.

Professor Blount's conclusions are interesting and undoubtedly correct, and show how sensitive wheat is to causes affecting its development.

Arrested development may apparently produce two results, according to the period in the growth of the plant at which it occurs. In the Colorado specimens, as Professor Blount remarks, the supply of nitrogen was probably cut off by the injury done by storms. In the cases of the Ohio wheats, which owed their small size and shriveled appearance to wet weather just before harvesting, the check to development came after the nitrogenous portion of the seed had been stored up and prevented the accumulation of the starch which was necessary to make a plump grain.

Professor Blount proposes to continue his experiments, and it will be very interesting to observe the quality and composition of succeeding crops.

In 1882 the product of several seed wheats sent to Colorado in 1881 was found to be much richer in albuminoids than the original seed and in our previous bulletin attention was called to this fact. Of the last year's crop eight varieties were from seed sent to Professor Blount from Washington.

A comparison of the analyses will show the changes during the past unfavorable season.

Comparison of Department seed and Colorado crops, 1882–'83.

Serial number.	Weight of 100 grains.		Water.		Ash.		Albuminoids.		Nitrogen.	
	Seed.	Crops.	Seed.	Crops.	Seed.	Crops.	Seed.	Crops.	Seed.	Crops.
	Grams.	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
2173	4.152	.....	9.84	.....	1.73	.....	9.98	.....	1.60	.....
2174	.....	4.182	.....	9.69	.....	2.19	.....	11.20	.....	1.79
2175	3.650	.....	9.40	.....	1.94	.....	11.73	.....	1.88	.....
2176	.....	3.650	.....	9.50	.....	2.10	.....	13.65	.....	2.18
2177	2.820	.....	9.74	.....	1.94	.....	12.60	.....	2.02	.....
2178	.....	4.594	.....	9.55	.....	1.95	.....	12.95	.....	2.07
2179	4.336	.....	9.90	.....	1.86	.....	10.33	.....	1.65	.....
2180	.....	4.957	.....	10.25	.....	2.10	.....	12.43	.....	1.99
2181	2.612	.....	11.35	.....	1.75	.....	12.60	.....	2.02	.....
2182	.....	3.231	.....	11.11	.....	2.04	.....	12.60	.....	2.02
2183	4.084	.....	10.50	.....	1.95	.....	9.80	.....	1.57	.....
2184	.....	3.818	.....	9.44	.....	2.17	.....	11.38	.....	1.82
2185	3.062	.....	10.38	.....	1.89	.....	10.15	.....	1.62	.....
2186	.....	2.879	.....	9.21	.....	2.04	.....	10.33	.....	1.65
2187	3.138	.....	9.48	.....	2.56	.....	16.45	.....	2.63	.....
2188	.....	4.064	.....	9.92	.....	2.20	.....	14.53	.....	2.32
Average	3.482	3.922	10.07	9.83	1.95	2.10	11.71	12.38	1.88	1.98
Gain	.....	6	.....	3	.....	7	.....	7	.....	7
Loss	.....	2	.....	5	.....	1	.....	1	.....	1

The averages show that the crop, notwithstanding unfavorable conditions, has improved in ash and albuminoids and size of the grain, and that the conclusions of previous analyses are verified. The last variety, No. 2187–8, was the only one to lose in percentage of albuminoids, and this was plainly because it contained in the seed a higher amount than could be supported by Colorado conditions in the crop.* This same wheat, the Geiger, a spring variety from Asia, it will be noticed contains a large amount of ash in connection with its high percentage of albuminoids, and loses the one with the decrease of the other. Attention has already been drawn to the intimate relation between ash and albuminoids in the whole grain in the previous report, and the reason of this will appear in later analyses where it is shown that the bran and germ, both storehouses of nitrogen, contain large amounts of ash.

That Colorado is a place where a rich and fine wheat can be raised is evident from the work of the past three years; but it is also plain that all the aid which human agency can control must be given to this end. Two samples of wheat grown in another part of the State, Fremont County, which have been in the Department Museum for some time, are not rich in albuminoids, containing each only 9.80 per cent. This variation shows that great care is always necessary to keep the grain at a high standard and that in the case of the wheats from Fremont County something was lacking.

THE PACIFIC COAST.

The conclusion was drawn from analyses completed last year that Oregon produced a wheat extremely poor in albuminoids, although the

*See Bulletin No. 1, p. 43.

appearance of the grain was fair and large; and it was surmised that grain from the whole Pacific slope might possess the same peculiarity. Surprise having been expressed at this statement, it was suggested that an analysis should be made of a selected sample of Oregon wheat, of the crop of 1883. For this purpose a specimen was chosen which the Northern Pacific Railroad presented to its guests at a dinner in Walla Walla, during the excursion given by the road in the autumn of 1883. The result (serial No. 1854) was a complete confirmation of previous analyses. The percentage of albuminoids found was 7.70, and this determination having been confirmed by duplication, the wheat was proved to be the lowest in albuminoids of any that have been examined in this country. Its appearance was fine, but the size of the grain smaller than one usually expects in Oregon wheats. Further on it will be seen that this peculiarity of poverty in albuminoids among Oregon wheats is confirmed by the analysis of a new process flour made in that State which was found to contain only 7.18 per cent.

All attempts to obtain typical samples of the crops of 1883 from California having failed it was necessary to fall back upon a series of wheats from that State in the Museum of this Department, which were of the crops of 1875 and were exhibited at the Exhibition at Philadelphia. While more recent specimens would be more desirable, there can have been no changes in the amount of nitrogenous constituents, the chief alteration of the grain being in the amount of water which it would contain.

The average derived from the ten analyses follows:

Average composition of California wheat from San Joaquin, Contra Costa, and El Paso Counties.

Wheat of 100 grains	grams	3.8924
Water	per cent	10.73
Ash	do	1.86
Undetermined	do	76.47
Albuminoids	do	10.94
Total		100.00
Nitrogen	per cent	1.75

This average is not as low as that for Oregon, but is far below (1 per cent.) the average of the country. It represents but a limited portion of the State, and while it points to the correctness of the assumption of the poverty of the wheats of the Pacific slope in albuminoids it does not render it positive, as several of the specimens contain over 12 per cent.

In the report of the Census for 1880, Professor Brewer, in his collection of analyses of cereals, gives four of California wheat, two of which, described as hard, are the celebrated Macaroni wheats and contain

13.76 and 12.84 per cent. of albuminoids, and two are white wheats containing only 8.25 and 9.69 per cent. From these results it would seem that the hard wheats are more able to collect nitrogen than the soft white varieties, and as the specimens from Oregon have been all of the latter kind, the low percentage of nitrogen may be due to that fact. It would be of interest to examine a hard red wheat grown in that State.

ADDITIONAL ANALYSES.

Allusion has been made to the collection of analyses of cereals by Professor Brewer in his report to the Census of 1880.* Such of the wheat analyses as have not been inserted in the previous bulletin are here published for the purpose of presenting, as a whole, all analyses which have been made of American specimens.

*Tenth Census of the United States, Vol. III, Statistics of Agriculture, p. 414.

ANALYSES OF WHEATS FROM OTHER SOURCES THAN THE DEPARTMENT OF AGRICULTURE.

Name.	Locality.	Year.	Spring or winter.	Water.	Ash.	Fat.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Analyst.
				Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
Amber-bearded	Maine		Spring	13.35	1.79	2.00	69.06	1.99	11.81	1.89	U. S. Census.
White Winter	New York		Winter	13.07	1.63	1.65	71.23	1.79	10.63	1.70	Do.
Red Winter	do		do	13.30	1.70	1.59	68.08	1.73	13.60	2.18	Do.
From limestone land	New Jersey		do	13.30	2.09	1.70	69.62	1.90	11.39	1.82	Do.
From gray rock, gravel soil	do		do	13.67	1.82	1.74	68.34	1.93	12.50	2.00	Do.
No 1 white winter	Michigan		do	12.89	1.85	1.56	70.74	1.90	11.06	1.77	Do.
Fultz	Wisconsin		do	12.34	1.89	1.62	71.30	1.76	11.09	1.77	Do.
Red Mammoth	do		Spring	12.13	2.30	2.07	66.07	2.30	15.13	2.42	Do.
Spring wheat	Minnesota		do	11.13	1.95		*72.92		14.00	2.24	Kedzie.
Scotch Fife	Dakota		do	12.60	1.98	1.82	68.09	2.01	13.50	2.16	U. S. Census.
Scotch Fife	do		do	12.90	1.77	1.82	68.33	1.93	13.25	2.12	Do.
Macaroni	California	1879	Winter	10.70	1.97	1.46	70.21	1.90	13.76	2.20	Do.
Macaroni	do	1879	do	10.93	1.45	1.63	71.40	1.75	12.84	2.05	Do.
White Club	do	1879	do	11.23	1.93	1.67	74.78	2.14	8.25	1.32	Do.
No. 1, San Francisco Produce Exchange	do	1879	do	11.03	1.78	1.77	73.58	2.15	9.69	1.55	Do.

* Fiber, carbhydrates, and fat.

AVERAGES.

The analyses completed during the past year numbered one hundred and forty-seven, the specimens being divided among different portions of the country as follows:

Eastern and Gulf States	9
Middle States	44
Western States	80
Pacific States	12
British Provinces	2

Averages derived from the results of these analyses are here given, and also those obtained by a combination of all results up to this time:

Locality.	Number of analyses.	Number of weights.	Weight of 100 grains.	Water.	Ash.	Undetermined.*	Albuminoids.	Nitrogen.	Weights.		Albuminoids.	
									Highest.	Lowest.	Highest.	Lowest.
			Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Grams.*	*Grams.*	*Per cent.*	*Per cent.*
United States and British Provinces	147	142	3.653	9.97	2.06	77.44	10.53	2.01	5.800	2.584	18.03	7.70
Atlantic States	9	6	3.900	11.54	2.06	74.83	11.57	1.85	4.447	3.465	12.78	10.33
Middle States	44	42	3.458	10.71	1.95	74.48	12.86	2.06	5.800	2.663	16.10	10.68
Western States	80	80	3.717	9.58	2.16	75.55	12.71	2.03	5.578	2.716	18.03	8.93
Manitoba	2	2	3.288	8.34	1.63	75.50	14.53	2.32	3.465	3.111	15.58	13.48
Pacific States	12	12	3.853	10.59	1.88	77.04	10.49	1.68	5.184	2.584	12.78	7.70
Pennsylvania	1			11.30	2.03	73.54	13.13	2.10				
Virginia	4	3	3.762	8.98	2.22	76.90	11.90	1.90	4.255	3.465	12.78	11.03
West Virginia	2	1	3.392	8.55	2.07	78.44	10.94	1.75			11.03	10.85
Alabama	2	2	4.362	9.80	1.74	77.70	10.76	1.72	4.447	4.247	11.20	10.33
Ohio	42	42	3.458	10.74	1.94	74.43	12.89	2.06	5.800	2.663	16.10	10.68
Illinois	1			9.05	2.06	76.46	12.43	1.99				
Tennessee	1			10.02	2.32	74.51	12.25	1.96				
Arkansas	1			9.56	2.52	74.97	12.95	2.07				
Minnesota	4	4	3.001	8.51	1.91	75.19	14.30	2.31	3.577	2.720	15.23	13.83
Dakota	10	10	3.151	8.51	1.94	74.11	15.44	2.47	3.700	2.771	18.03	12.43
Manitoba	2	2	3.288	8.35	1.63	75.49	14.53	2.33	3.465	3.111	15.58	13.48
Colorado	61	61	3.931	9.85	2.21	75.63	12.31	1.97	5.578	2.716	14.53	8.93
Utah	2	2	3.893	9.17	2.23	78.45	10.15	1.62	4.084	3.703	10.50	9.80
New Mexico	2	2	3.572	9.30	1.98	78.22	10.50	1.68	3.956	3.188	11.73	9.28
California	10	10	3.892	10.73	1.86	76.47	10.94	1.75	5.184	3.095	12.78	9.10
Washington Territory	2	2	3.655	9.89	1.98	79.90	8.23	1.32	4.726	2.584	8.75	7.70

* Fiber, carbhydrates, and fat.

AVERAGE COMPOSITION OF AMERICAN WHEATS.

Locality.	Number of analyses.	Number of weights.	Weight of 100 grains.	Water.	Ash.	Undetermined.*	Alhuminoids.	Nitrogen.	Weight of 100 grains.		Albuminoids.	
									Highest.	Lowest.	Highest.	Lowest.
			Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Grams.*	*Grams.*	*Per cent.*	*Per cent.*
United States and British America	407	377	3.644	10.16	1.92	75.77	12.15	1.94	5.924	1.830	18.03	7.70
Atlantic and Gulf States	117	105	3.489	10.34	1.77	76.54	11.35	1.81	5.079	1.830	15.58	9.43
Middle States	91	89	3.537	10.61	1.85	75.04	12.50	2.00	5.800	2.138	16.63	10.15
Western States	177	166	3.763	9.83	2.06	75.37	12.74	2.04	5.924	2.561	18.03	8.93
Pacific States	20	15	4.091	10.25	1.87	78.15	9.73	1.56	5.745	2.584	12.78	7.70
Canada	6		3.325	9.74	1.56	77.83	10.87	1.74	3.686	2.964	14.70	9.45
Pennsylvania	33	26	3.373	10.73	1.70	76.13	11.44	1.83	4.658	2.035	15.58	9.45
Maryland	9		3.597	10.52	1.75	76.08	11.65	1.86	5.079	3.075	14.53	9.80
Virginia	15	14	3.433	9.98	1.84	76.08	12.10	1.93	4.283	1.830	14.00	10.15
West Virginia	2	1	3.392	8.55	2.07	78.44	10.94	1.75			11.03	10.85
North Carolina	22		3.776	10.03	1.59	77.95	10.43	1.67	4.628	2.780	12.43	8.93
Georgia	7		3.579	10.00	1.96	76.26	11.78	1.89	4.627	2.834	14.00	9.45
Alabama	19	19	3.424	10.82	1.96	75.93	11.29	1.89	4.647	2.011	13.65	9.80
Ohio	44	44	3.476	10.68	1.94	74.55	12.83	2.05	5.800	2.663	16.10	10.68
Tennessee	15	14	3.150	10.24	1.92	75.34	12.50	2.00	3.990	2.138	16.63	10.15
Kentucky	8		3.454	10.83	1.75	74.27	13.15	2.10	3.666	3.146	14.53	11.90
Michigan	22		3.969	10.71	1.64	75.98	11.67	1.87	4.902	3.402	15.23	10.50
Missouri	12		3.502	9.80	1.92	76.72	11.56	1.86	3.867	3.098	14.00	10.50
Arkansas	1			9.56	2.52	74.97	12.95	2.07				
Minnesota	13	13	3.245	9.96	1.77	75.08	13.19	2.11	3.867	2.720	17.15	10.85
Dakota	12	12	3.149	8.84	1.96	74.25	14.95	2.40	3.700	2.771	18.03	12.43
Manitoba	2	2	3.288	8.35	1.63	75.49	14.53	2.32				
Kansas	10		3.204	11.80	1.64	75.41	11.15	1.78	3.424	2.881	12.25	10.50
Texas	19		2.847	10.03	1.81	75.02	13.14	2.10	3.937	2.561	15.23	10.68
Colorado	106	98	4.214	9.73	2.21	75.33	12.73	2.03	5.924	2.716	15.94	8.93
Utah	2	2	3.893	9.17	2.23	78.45	10.15	1.62	4.084	3.703	10.50	9.80
New Mexico	2	2	3.572	9.30	1.98	78.22	10.50	1.68	3.956	3.188	11.73	9.28
California	10	10	3.892	10.73	1.86	76.47	10.94	1.75	5.184	3.095	12.78	9.10
Oregon	8		5.044	9.74	1.84	79.82	8.60	1.37	5.745	4.253	9.47	8.05
Washington Territory	2	2	3.655	9.89	1.98	79.90	8.23	1.32	4.726	2.584	8.75	7.70

* Fiber, carbhydrates, and fat.

Owing to the fact that the wheats were this year nearly all from the Middle States and the West, they average more nearly the composition shown previously for the Western country.

Colorado has fallen off somewhat, owing to its poor crop, but the high percentage of albuminoids in the Ohio samples has counteracted this result, and the general average for the whole country, derived from the 407 samples analyzed, is somewhat higher than last year.

The general conclusions of the previous bulletin are, however, not essentially altered.

CHEMISTRY OF THE ROLLER MILLING PROCESS OF GRADUAL REDUCTION.

It is the object of milling to reduce the floury portion of the wheat-grain to the finest possible form without injuring its physical condition, and at the same time with complete exclusion of portions of the bran and germ, and such refuse products as would injure its baking qualities and color. An examination of the structure of the grain will enable us to understand the difficulties to be met and the way in which the different products which have been analyzed are obtained.

If a blade of wheat were much thickened and the two halves then folded back upon themselves a transverse section of it would represent a similar section of the grain, that is to say the two lobes would meet, forming what is known in the grain as the crease within which would be inclosed and hidden a portion of the outer covering. This explains how difficult it is in preparing the wheat for milling to remove all the foreign matter which this crease contains. On the exterior of the grain there is found toward one end a collection of hair, and at the other end appears the embryo or germ. A longitudinal section shows both of these undesirable additions to the floury matter of the grain. Aside from its exterior appearance the wheat-grain is essentially an embryo, the germ, together with a supply of food, the endosperm or floury matter, surrounded by several membranes or coats of greater or less importance. On the exterior is the first membrane or *cuticle*, a very thin coating, easily removed by rubbing. Next follows a more important, because thicker, portion of the outer covering, consisting of two layers of cellular tissue, the *epicarp* and *endocarp*. These three membranes together form the outer covering of the grain, and from one of them, the epicarp, spring the hairs which are found on one end. These envelopes are colorless and very light, constituting only from 3 to 3½ per cent. of the whole, and are more or less easily removed by friction. From an examination of a section of the grain it is seen that within the crease this is of course impossible, so that while the preparation of the wheat for milling may remove the hairs and much of the cuticle and dirt it cannot completely free it from them. It is this inherent difficulty that the roller mills attempt to overcome by splitting the grain along the crease and afterwards cleaning it with brushes.

Under these outer coverings are three membranes, known as the *testa* or *episperm*, the *tegmen*, and the *embryous envelope*. The testa is a compact affair, and carries the coloring matter of the bran. The tegmen is an extremely thin membrane not easily seen except where it becomes thick and just under the testa in the heart of the crease. It is not of importance from a milling point of view. The testa and tegmen form about 2 per cent. of the grain.

The *embryous membrane* is a continuation of the embryo around the endosperm or floury portion of the grain. It is composed of cells which are often erroneously termed gluten cells, but the true gluten cells are scattered through the endosperm. The cells of the embryous membrane contain little or no gluten, and as they are a continuation of the embryo it must be nearly as undesirable to allow them in the finished flour as the germ itself.

The endosperm is by far the largest portion of the grain, and it is that which is the object of all milling processes to separate from the rest of the wheat and grind to flour.

It consists of large cells containing the granules of starch and the gluten. At the exterior, nearer the embryous membrane, it is much harder than in the center and contains much more gluten. In all methods of gradual reduction, therefore, the center is of course reduced first, and, being very starchy, is only fit for a low-grade flour, while the richest part of the endosperm, being harder and closely attached to the tough bran coats, is to a certain extent lost, or so contaminated with small pieces of the bran as to injure the color of the flour, furnishing what is known as bakers' grades.

By the old-fashioned low-milling process, or grinding between stones placed very close together and bolting, it was impossible to obtain a flour entirely free from contamination. The advance to high milling with stones far apart, allowing the middlings which were produced to be purified before grinding to flour, was a step which made it possible to make from winter wheat an excellent and pure flour. When, however, spring wheat, with its hard and brittle outer coats, became important commercially, it was necessary to resort to the roller methods of milling, which, in conjunction with peculiar purifying machinery, would furnish a flour free from all undesirable impurities.

This process is so complete that an examination and chemical analysis of the products are of great interest, as showing how the different constituents of the grain are divided. It is unnecessary, however, to describe the process itself, long accounts of which can be found in the millers' journals of the day and in the Census of 1880, Vol. III, Statistics of Agriculture. It is sufficient merely to know the names of the products and the portion of the grain from which they come.

The first series, consisting of seventy-two specimens, is from the mill of C. A. Pillsbury & Co., Minneapolis, Minn., known as the Pillsbury

"A." This mill, it may be of interest to know, is described in the Census report previously mentioned. It uses the "*hard spring wheat*," which is grown in the Northwest, and its products, therefore, are typical of this particular variety.

The second partial series is from the mill of Herr & Cissel, in Georgetown, D. C., and the wheat used at the time the specimens were collected was a mixture of Virginia "*Fultz*" and "*Longberry*." Their products are illustrative, therefore, of the effect of the roller process on Virginia winter wheat.

The third partial series consists of a few specimens resulting from the milling of Ohio winter wheat by Warder & Barnett, of Springfield, Ohio, by the same methods as the others.

The Minnesota samples, being more numerous, will be taken up first.

PARTS OF THE WHEAT GRAIN IN DIFFERENT MILL PRODUCTS.

2001. *Wheat as it enters the mill.*

The whole wheat grain mixed with cockle, oats, and other foreign seed, as it comes from the thrasher.

2002. *Wheat prepared for the rolls.*

The foreign seeds have been removed with the exception of a few grains of cockle and oats. The cockle is therefore to be found in subsequent parts of the process. The hairs have been largely rubbed off, together with portions of the cuticle. Some hairs are, however, still left, and portions of the cuticle remain attached and semi-detached, especially toward the crease. The grain as a whole presents a changed and much cleaner appearance.

2003. *Cockle and screenings.*

Among the foreign seeds there are found principally cockle and a species of polygonum and oats, together with broken pieces of wheat, dirt, chaff, &c.

2004. *Scourings removed by cleaners.*

These consist almost entirely of cuticle and hairs, but portions of epicarp, with the hairs still adherent, and of endocarp are present. Treatment with iodine reveals a small amount of endosperm or starch, and shows the inner part of the outer coats of the grain are the most highly nitrogenous. The contrast between the embryous membrane and endocarp, and the epicarp and cuticle is prominent. The embryous membrane is recognized by its roundish cells; the endocarp by its transverse cells, twice as long as broad, and packed closely and regularly, like cigars, which has given it the name of cigar coat, and the epicarp by its very long and irregular cells arranged longitudinally, the cuticle being of a similar sort.

2005. *First break.*

The grain is split along the crease normally into two halves, but also frequently into fours, or even more irregularly. The glistening, hard, floury endosperm makes its appearance for the first time. Comparatively little flour or dust is made.

2006. *Chop from first break.*

This consists principally of endosperm, but small portions of bran * and germ are present the former, including all the various outer coats.

* Bran is used in this description as denoting and including any part of the coats of the grain.

2007. *Second break.*

In this break the greater part of the endosperm is separated from the bran, and is seen as large well-shapen middlings, together, of course, with some small stuff and dust.

2008. *Chop from second break.*

This is chiefly endosperm, with somewhat less bran than the previous chop. Whole germs and parts are numerous. The endosperm is of all sizes, but the greater portion of large angular fragments. The bran includes portions of all the outer coverings, while dusty matter and starch grains are quite abundant.

2009. *Third break.*

The endosperm is so completely separated in this break that it only remains in scattered patches upon the bran, and the embryous membrane is quite visible.

2010. *Chop from third break.*

The middling or particles of endosperm are much finer, and there is more dust. Small portions of germ are plentiful. The branny particles are similar in nature to those in the last chop but smaller, and there is more dust of a nitrogenous kind.

2011. *Fourth break.*

Only to be distinguished from No. 2009 by the slightly cleaner bran.

2012. *Chop from fourth break.*

Not very different in appearance from 2010, except that it is composed of more finely divided particles.

2013. *Fifth break.*

Still cleaner bran than 2011. It still holds a very appreciable portion of endosperm.

2014. *Chop from fifth break.*

A chop contains a great deal of branny matter, including pieces of epicarp, endocarp, and embryous membrane. The endosperm is very fine and much mixed with germ. Of course, in all these products, portions of the testa and tegmen are present, but they are not easily seen except in careful preparations.

2015. *Sixth break.*

Barely distinguishable from bran.

2016. *Chop from sixth break.*

Very largely made up of small pieces of branny material and germs. The endosperm which is present is very fine.

2017. *Bran.*

This is composed practically of epicarp, endocarp, and embryous membrane, the cells of the latter having been very little disturbed. There is still a little cuticle and endosperm left, but they have mostly disappeared in previous operations.

2018. *Shorts.*

These are made up of all the different parts of the grain in rather a fine condition, some of the branny particles having endosperm still adherent to them.

2019. *Middlings, Uncleaned No. 1.*

These are the largest sized middlings, and consist in themselves of clean, angular fragments of endosperm, but they are mixed with considerable shorts and many whole and broken germs. They are the most impure of the five, and an analysis will show this fact.

2020. *Middlings, Uncleaned No. 2.*

All the particles are finer than in the previous middlings, and less germ and bran is present, which will produce a corresponding change in their chemical composition.

2021. *Middlings, Uncleaned No. 3.*
Still finer than No. 2, and less bran and germ.
2022. *Middlings, Uncleaned No. 4.*
Finer than No. 3, and less bran and germ.
2023. *Middlings, Uncleaned No. 5.*
The finest of all the middlings, with almost no bran and germ. The effect of cleaning will be small.
2024. *Middlings, Cleaned No. 1.*
Many of the lighter particles of bran removed, but there is much remaining, as well as of the germ.
2025. *Middlings, Cleaned No. 2.*
The bran is to a large degree removed in cleaning these middlings, but the germ of course remains.
2026. *Middlings, Cleaned No. 3.*
The bran is almost all gone.
2027. *Middlings, Cleaned No. 4.*
These middlings are practically quite clean and pure endosperm. Only here and there a particle of bran or germ.
2028. *Middlings, Cleaned No. 5.*
Quite clean, and very small in size.
2029. *First middlings, reduction on smooth rolls.*
The germ is flattened, and the endosperm reduced in size.
2030. *Chop from first reduction of middlings.*
This sample appears to be misplaced, as it contains much bran and germ.
2031. *Second middlings, reduction on smooth rolls.*
A sample of this reduction was not furnished.
2032. *Chop from second reduction of middlings.*
This chop contains a few particles of bran and germ.
2033. *Third middlings, reduction on smooth rolls.*
The germ is prominent in its flattened condition.
2034. *Chop from third reduction of middlings.*
The bran and germ have been almost entirely removed.
2035. *Fourth middlings, reduction on smooth rolls.*
Like the middlings themselves, merely reduced in size.
2036. *Chop from fourth reduction of middlings.*
Here and there a small particle of bran seen.
2037. *Fifth middlings, reduction on smooth rolls.*
Resembles of course the fifth middlings.
2038. *Chop from fifth reduction of middlings.*
This is not as white as the chop from the fifth reduction, as it contains bran and germ in small quantities.
2039. *Flour from the first reduction.*
The grains of endosperm are clean and sharp.
2040. *Flour from the second reduction.*
The grains are not as sharp as those from the first reduction.
2041. *Flour from the third reduction.*
Very much like the flour from the second reduction, but perhaps a little lumpier.
2042. *Flour from the fourth reduction.*
More coherent and yellower than previous flours.
2043. *Flour from the fifth reduction.*
There is no specimen of this flour.
2044. *Tailings from middlings purifier No. 1.*
These tailings are coarse. They contain much bran, mixed with germ, and a considerable amount of large middlings.

2045. *Tailings from middlings purifier Nos. 2, 3, and 4.*
Much finer than the previous tailings and freer from germ and endosperm.

2046. *Tailings from middlings purifier No. 6.*
Largely composed of fine endosperm, mixed with bran and germ.

2047. *Tailings from the first reduction.*
These are made up of about equal parts of fine endosperm and of bran and germ.

2048. *Tailings from the second reduction.*
These are finer than the first tailings, and contain more germ. There are also present pieces of endosperm, flattened like the germ.

2049. *Tailings from third reduction.*
Still finer, with much-flattened endosperm, and less grain and bran.

2050. *Tailings from fourth reduction.*
Very finely divided and flattened endosperm, with only about 10 per cent. of bran and germ. This should be very evident in the analysis.

2051. *Tailings from fifth reduction.*
Coarser than the fourth tailings, and like the third in quality.

2052. *Repurified middlings.*
Coarse pieces of endosperm, with much bran and germ.

2056. *Bakers' flour.*
Slightly yellow in color. The grains lack distinctness, making the flour lumpy.

2057. *Patent flour.*
A clear white grain.

2058. *Low-grade flour.*
The grain is soft and the flour dark and lumpy. Particles of bran and germ are prominent.

2059. *Break flour.*
Physically like the bakers' grade in appearance, but particles of bran and germ are present, making it of less value.

2060. *Stone flour.*
This flour is white, of a fair grain, with a very little bran.

2062. *Flour from first tailings.*
A very good, free grain, but a little branny.

2063. *Flour from third tailings.*
A free grain, but quite branny and yellow.

2064. *Flour from second tailings.*
This flour resembles that from the first tailings, but contains more bran and is yellower.

2070. *First germ.*
This is made up of the finest particles of germ and contains the largest proportion of middlings and bran.

2071. *Second germ.*
The largest particles of germ, with little bran and endosperm.

2072. *Third germ.*
A medium between the two former.

2074. *Bran-duster flour.*
This is black in color and lumpy. It has little grain and a small portion of bran.

2077. *Stone stock No. 2.*
A good middling, with a little bran and germ.

2078. *Stone stock No. 3.*
This is not as good as No. 2, and holds more bran and germ.

2083. *Tailings from sixth break.*
This is made up of about half barley shaped and flattened pieces of endosperm, the rest being bran, with a little germ.

2084. *Tailings from first centrifugal reel.*

Largely flattened endosperm; the rest germ, with a little bran.

2085. *Tailings from second centrifugal reel.*

These are largely bran and flattened endosperm with a little germ.

2086. *Tail end of the tailings.*

As would be expected, almost entirely bran, with a little adherent endosperm and a small amount of germ. The embryous membrane is still in place; in fact during the whole process there is very little of it removed from the bran, and were it the chief source of gluten there would be very little in any of the products. This, however, is not the case. It contains little or no gluten, being merely a continuation of the germ and having a similar composition.

2087. *Dust from No. 1 middlings.*

This is mostly cuticle epicarp and hairs, with smaller amounts of the more interior parts of the grain.

2088. *Dust from the dust-catcher.*

This is all light, fluffy matter, and is made up of small particles from all parts of the grain.

These observations upon the proportions in which the different portions of the grain enter into the various products enable us to understand and interpret the chemical analyses which follow with greater clearness than could otherwise be done, and it will be seen afterward that with a knowledge of the constituents of the different parts, of bran, the germ and the endosperm, it is comparatively easy to predict almost the exact composition of any of the mill products from the above data.

Serial number.	Names.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Phosphoric acid.	Ratio nitrogen to phosphoric acid.	Gluten.	
											Moist.	Dry.
	C. A. Pillsbury & Co., Minneapolis, Minn.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
2001	Wheat as it enters the mill	9.66	1.91	2.61	69.94	1.70	14.18	2.27	.82	2.77	.....	.....
2002	Wheat prepared for the rolls	9.07	1.79	2.74	70.37	1.68	14.35	2.30	.82	2.80	32.31	11.88
2003	Cockle and screenings	9.03	2.65	4.32	66.12	4.23	13.65	2.18	.78	2.80	.....	.....
2004	Scourings removed by cleaners	9.27	3.68	3.73	70.19	1.58	11.55	1.85	.76	2.43	.....	.....
2005	First break	8.23	1.73	2.68	71.56	1.62	14.18	2.27	.91	2.49	31.92	11.69
2006	Chop from first break	12.52	.88	2.08	70.44	1.13	12.95	2.07	.46	4.50	34.10	12.27
2007	Second break	8.37	2.04	2.47	71.47	1.65	14.00	2.24	.98	2.29	32.78	11.80
2008	Chop from second break	12.78	.57	1.68	71.82	.55	12.60	2.04	.34	5.94	36.88	12.56
2009	Third break	9.92	2.55	5.25	65.10	2.13	15.05	2.41	1.33	1.81	32.09	12.04
2010	Chop from third break	12.70	.78	1.86	71.10	.78	12.78	2.04	.42	4.86	37.19	13.00
2011	Fourth break	8.18	3.30	4.09	66.20	3.00	15.23	2.44	1.44	1.07	27.88	10.54
2012	Chop from fourth break	12.35	1.47	2.87	67.90	1.23	14.18	2.27	.75	5.05	30.52	11.64
2013	Fifth break	7.62	5.16	4.91	61.76	4.80	15.75	2.52	2.58	.98	.....	.....
2014	Chop from fifth break	11.91	1.99	4.16	64.46	1.73	15.75	2.52	1.01	2.49	27.97	11.82
2015	Sixth break	7.66	5.68	5.34	59.42	5.69	16.28	2.60	2.95	.81	.....	.....
2016	Chop from sixth break	11.84	3.29	4.92	59.09	3.18	17.68	2.83	1.66	1.70	24.04	10.69
2017	Bran	10.91	5.59	5.03	56.21	5.98	16.28	2.60	2.78	.94	.....	.....
2018	Shorts	10.94	3.41	4.67	60.28	3.90	16.80	2.69	1.62	1.66	.....	.....
	Middlings uncleaned:											
2019	No. 1	12.71	1.27	2.73	68.78	1.03	13.48	2.16	.64	3.39	29.68	10.57
2020	No. 2	12.18	1.04	2.16	70.49	.83	13.30	2.13	.54	3.94	32.99	11.49
2021	No. 3	12.27	.70	1.80	71.52	.58	13.13	2.10	.36	5.83	35.52	12.21
2022	No. 4	12.47	.68	1.75	70.69	.58	13.83	2.21	.40	5.52	45.62	15.69
2023	No. 5	12.34	.61	1.75	70.24	.53	14.53	2.32	.33	7.03	43.82	14.86
	Middliogs cleaned:											
2024	No. 1	12.67	1.07	2.12	70.16	.85	13.13	2.10	.59	3.56	34.03	11.16
2025	No. 2	9.93	.65	1.90	74.09	.65	12.78	2.04	.33	6.18	.....	.....
2026	No. 3	12.36	.59	1.70	71.67	.55	13.13	2.10	.24	8.75	44.43	14.99
2027	No. 4	12.51	.52	1.77	71.57	.33	13.30	2.13	.29	7.34	51.93	17.85
2028	No. 5	12.35	.51	1.62	70.74	.43	14.35	2.30	.23	10.00	46.15	14.87
	Middlings, reduction on smooth rolls:											
2029	First middling	12.64	.82	2.56	70.80	.58	12.60	2.02	.46	4.39	34.20	11.57
2030	Chop from first middling	12.74	.72	1.99	71.72	.58	12.25	1.96	.40	4.90	32.16	10.91
2031	Second middling	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2032	Chop from second middling	12.48	.57	1.68	71.24	.38	13.65	2.18	.34	6.41	41.36	13.65
2033	Third middling	12.29	.61	1.86	71.91	.55	12.78	2.04	.34	6.00	36.70	11.81
2034	Chop from third middling	12.73	.79	2.01	71.29	.58	12.60	2.02	.43	4.70	34.58	11.68
2035	Fourth middling	11.43	.56	1.86	73.12	.43	12.60	2.02	.34	5.94	37.00	12.23
2036	Chop from fourth middling	11.72	.50	1.76	72.56	.33	13.13	2.10	.27	7.78	42.06	12.32

2037	Fifth middling	12.21	.65	2.08	71.85	.43	12.78	2.04	.40	5.10	36.25	11.97
2038	Chop from fifth middling	11.47	.56	2.03	72.66	.50	12.78	2.04	.37	5.57	40.84	13.11
	Flour from reduction of middlings:											
2039	First	12.03	.39	1.58	73.70	.25	12.05	1.93	.24	8.04	31.51	10.97
2040	Second	12.42	.44	1.66	72.55	.33	12.60	2.02	.24	8.42	37.04	12.07
2041	Third	11.54	.38	1.36	75.24	.28	11.20	1.70	.19	9.42	32.54	10.99
2042	Fourth	11.58	.40	1.42	72.92	.38	13.30	2.13	.20	10.65	37.90	12.52
2043	Fifth											
	Tailings from middlings purifiers:											
2044	No. 1	12.33	3.30	4.96	60.06	3.25	16.10	2.55	1.61	1.60		
2045	Nos. 2, 3, and 4	11.59	3.09	3.92			14.53	2.32	1.39	1.67	12.28	7.62
2046	No 6	12.00	.90	2.37	69.10	1.10	14.53	2.32	.49	4.73	39.88	14.37
	Tailings from reduction:											
2047	First	11.78	3.26	5.03	60.32	2.63	16.98	2.72	1.82	1.47	13.04	5.47
2048	Second	10.35	3.38	4.37	59.87	2.08	19.95	3.19	1.68	1.90		
2049	Third	11.72	2.35	4.37	63.27	1.66	16.63	2.66	1.34	1.98		
2050	Fourth	12.09	.88	4 16	68.47	.40	14.00	2.24	.48	4.67	35.73	13.34
2051	Fifth	12.12	2.29	3.85	63.93	1.18	16.63	2.66	1.35	1.97	1.89	.67
2052	Repurified middlings	11.72	2.11	3.67	65.99	1.63	14.88	2.38	1.21	1.98	28.17	10.74
	Finished flour:											
2056	Bakers'	12.18	.62	2.00	69.99	.33	14.88	2.38	.31	7.68	51.21	16.97
2057	Patent	11.48	.39	1.45	73.55	.18	12.95	2.07	.18	11.50	36.14	10.85
2058	Low grade	12 01	1.99	3.86	63.26	.93	17.95	2.74	1.16	2.36	10.01	4.26
2059	Break flour	12 48	.58	1.87	69.44	.23	15.40	2.46	.31	7.94	51.38	15.87
2060	Stone flour	12.04	.49	1.61	72.85	.23	12.78	2.04	.27	7.55	38.21	11.74
	Flour from tailings:											
2062	First	12.55	.62	2.93	70.25	.35	13.30	2.13	.30	7.10	39.13	12.85
2063	Third	12.50	.85	2.79	70.20	.53	13.13	2.10	.45	4.67	37.78	12.68
2065	Second	11.20	.76	2.63	72.28	.48	13.65	2.18	.39	5.59	43.25	13.87
2068	Cockle chop	12.45	2.79	4.34	64.01	3.63	12.78	2.04	.86	2.37		
2069	Cockle bran	7.71	3.46	3.84	65.46	9.03	10.50	1.68	.83	2.02		
2070	First germ	8.69	3.42	9.35	53.28	1.23	24.13	3.86	1.83	2.11		
2071	Second germ	8.75	5.45	15.61	35.19	1.75	33.25	5.32	2.57	1.98		
2072	Third germ	7.68	4.94	13.75	39.25	1.50	32.88	5.26	2.56	2.05		
2074	Bran duster flour	11.78	1.17	2.70	70.20	.50	13.65	2.18	.66	3.30	58.59	13.72
	Stone stock:											
2077	No. 2	12.15	.40	1.64	72.91	.25	13.65	2.18	.19	11.58	47.55	15.32
2078	No. 3	12.01	.55	2.12	71.76	.43	13.13	2.10	.28	7.50	46.39	15.15
	Tailings:											
2083	From sixth break	11.64	2.29	4.06	64.31	1.95	15.75	2.52	1.23	2.05	16.45	6.17
2084	From first centrifugal reel	11.42	2.15	3.44	66.56	1.20	15.23	2.44	.98	2.49	6.58	2.39
2085	From second centrifugal reel	11.07	2.85	4.73	61.82	2.20	17.33	2.79	1.47	1.88		
2086	Tail end of the tailings	11.36	3.87	5.23			15.75	2.52	1.75	1.44	10.74	4.41
2087	Dust from No. 1 middlings	11.03	1.83	2.73	64.86	5.20	14.35	2.30	.55	4.18	25.78	10.31
2088	Dust from dust catcher	11.53	1.17	2.64	69.01	1.65	14.00	2.24	.55	4.07	35.05	13.00
	HERR & CISSEL, GEORGETOWN, D. C.											
2089	Mixed wheat, clean	9.62	1.93	2.29	71.83	1.55	12.78	2.04	.98	2.08	30.00	11.03
2090	First break	8.13	2.03	2.46	72.30	1.60	13.48	2.16	1.05	2.05	29.17	10.42
2091	Second break	9.47	2.00	2.01	71.81	1.58	13.13	2.10	.91	2.30	34.02	11.87
2092	Third break	8.79	2.03	2.37	71.98	1.70	13.13	2.10	1.10	1.90	29.24	10.32

ANALYSES OF THE PRODUCTS OF ROLLER MILLING—CONTINUED.

Serial number.	Names.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Phosphoric acid.	Ratio nitrogen to phosphoric acid.	Gluten.	
											Moist.	Dry.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*	*Per cent.*
2093	Fourth break	8.91	2.39	2.33	70.97	1.75	13.65	2.18	1.14	1.91	34.08	12.23
2094	Fifth break	7.18	3.46	.....	.....	.....	15.40	2.46	1.35	1.82	26.75	10.09
2095	Sixth break	9.38	4.76	.....	.....	.....	16.10	2.58	2.46	1.04	.....	.....
2096	First middling	11.96	.49	1.22	75.30	.35	10.68	1.71	.25	6.84	32.99	9.92
2097	Second middling	11.89	.51	1.21	75.56	.33	10.50	1.68	.25	6.72	35.49	10.55
2098	Third middling	10.88	.50	1.19	75.45	.25	11.73	1.88	.24	7.83	42.10	13.32
2099	First middling through smooth rolls	9.87	1.84	2.00	71.98	1.18	13.13	2.10	.87	2.42	28.97	10.59
2100	Patent flour	12.98	.32	.92	75.60	.20	9.98	1.60	.16	10.00	29.55	9.08
2101	Bakers' flour	13.29	.47	1.26	72.45	1.50	11.03	1.76	.28	6.28	35.04	11.30
2102	Low-grade flour	12.59	1.05	2.33	69.10	.75	14.18	2.27	.58	3.91	35.96	12.81
2103	Germ middlings	11.10	2.41	3.74	66.59	1.63	14.53	2.32	1.19	1.94	.....	.....
2104	Feed middlings or tailings	8.53	3.75	4.96	62.21	4.10	16.45	2.63	1.98	1.32	.....	.....
2105	Bran middlings	8.24	6.89	5.52	56.77	6.13	16.45	2.63	.98	2.68	.....	.....
	WARDER & BARNETT, SPRINGFIELD, OHIO.											
1855	Wheat	9.05	2.06	2.46	71.67	2.33	12.43	1.99	1.03	1.93	20.93	10.34
1856	Patent flour	12.32	.34	1.95	75.28	.33	10.68	1.71	.19	9.00	35.52	10.76
1857	Bakers' flour	11.98	.60	1.77	71.52	1.00	13.13	2.10	.33	6.36	38.29	12.30
1858	Low-grade flour	12.36	.69	1.00	75.04	.93	9.98	1.60	.30	5.33	28.37	9.96
1859	Middlings	8.49	4.28	5.94	60.64	3.15	17.50	2.80	1.12	2.50	.....	.....
1860	Bran	7.74	6.99	4.99	.....	.....	15.40	2.46	1.04	2.36	.....	.....
2190	Patent flour, second sample	13.59	.36	1.08	73.94	.35	10.68	1.71	.....	.....	.....	.....

INTERPRETATION OF THE ANALYSES.

The wheat as it enters the mill is subjected to a series of operations which removes dirt, foreign seed, the fuzz at the end of the berry, and a certain portion of the outer coats, through the agency of a run of stones and brushes. The result of this operation is to lower the amount of inorganic matter or ash and to increase or decrease the other constituents but slightly, the albuminoids being a few tenths of a per cent. greater in amount. The point from which a convenient start may be made is at the first break.

The chop from the first rolls is very marked in its difference in composition from the original wheat. It of course has less fiber, and also it is seen, less ash, oil, and albuminoids; in fact, it is starchy. It contains more water, owing to the fact that its comminution has allowed it to absorb the moisture from the air, and in general it will be observed that the coarser or more fibrous a specimen is the less water it contains, while the finer material holds more. For example, the percentage of water in several portions of the grain is as follows:

	Per cent.
Original grain	9.66
Ready for the break	8.23
Chop from first break	12.52
Fifth break	7.62
Bran	10 91

The heat caused by the friction of the process, of course, is an active agent; as may be seen on comparing the original grain and that ready for the break. The question of the relation of the various products to humidity is, however, considered in greater detail in another portion of this bulletin.

The starchy chop from the first break is carried off to the various purifying and grading machines, but for the present it will be left, as it is desirable to follow the breaks to the end.

The tailings from the first scalper, consisting of the wheat grain split open along the crease, which serve to feed the second break after the cleaning which they undergo, vary but little from the wheat which goes to the first break. There are slight differences which must be attributed to the difficulty of selecting and preparing for analyses samples of the product of the different breaks, the finer chop having a tendency to sift out from the lighter bran, but they are not great enough to vitiate the conclusions. In the first break so little is done, except to crack open the wheat and clean it for the following rolls, that only a small change should be expected.

The chop from the second break is more from the center of the wheat grain. It contains less ash, fat, and albuminoids than any of the break products, and includes as was shown by our preliminary investigation the greater portion of the endosperm.

The tailings supplying the third break already show, owing to the greater amount of chop produced on the second break, a marked increase in those constituents which are peculiar to the outer portions of the grain, that is to say, there has been a marked increase in ash, fiber, and albuminoids. This increase becomes still more apparent from break to break until the bran alone is left, which contains more ash and fiber than any other product of the wheat. The several chops increase in a like manner, the last or sixth break chop holding more albuminoids than the bran, and even any other of the resulting material. This is probably due to the comminution of the bran in the last break, and consequently, as will be seen, the middlings from this chop are richer in nitrogen than any other, although not the richest in gluten owing to the proportion of bran and germ which they contain.

Having followed the grain through the breaks to the bran, the products of the purification of the chop remain to be studied.

The shorts, or branny particles removed from the chop or from the middlings by aspirators, contain much less fiber and ash than the bran, although they are of similar origin, that is to say, from the outer coats of the grain. The analyses point to their origin from those portions of the coat which contain less ash and fiber.

The middlings are graded into five classes, and in their original uncleaned state they differ chemically in the fact that from No. 1 to No. 5 there is a regular decrease in ash, fiber, and fat, while No. 5 is richer in albuminoids than any other. This would be expected from our preliminary examination which showed a decrease in bran from beginning to end, and that No. 5 was the purest endosperm.

After cleaning the same relations hold good, but owing to the removal of the branny particles there is in all cases a loss of ash constituents and fiber. The effect of cleaning is more apparent in Nos. 1 and 2 where more bran is removed.

The reduction of the middlings on smooth rolls changes the composition but slightly, and the flours which originate from this process are very similar to the middlings from which they were produced. That from the fourth reduction is richer in nitrogen, as would also be the case with the fifth, although want of a specimen prevented an analysis.

The tailings from the middlings purifiers present the usual characteristics of by-products which owe their existence to the outer part of the grain with its high percentages of ash and fibre and, in this case also of nitrogen. It is remarkable, however, that the tailings marked No. 6 contain only one-third as much ash as the others, but this is explained by the fact that they are largely composed of endosperm.

The tailings from the different reductions are nearly alike in composition, with two exceptions: Those from the fourth contain little ash fiber and nitrogen. Like No. 6 of the purifier tailings they consist largely of endosperm. Those from the second reduction contain much germ, and are therefore richer in nitrogen than the rest.

The repurified middlings, as might be expected, contain much more ash, oil, and fiber than the original, and there is also an increase in nitrogen but not in gluten, owing to the large amount of bran they contain.

Analyses of the three grades of flour as furnished to the market follow. From a cursory glance it might be said that the low-grade flour was the best, as it contains the most albuminoids, but its weakness is discovered in the fact that it has only 4 per cent. of gluten. The bakers' flour contains more ash, oil, fiber, albuminoids, and gluten than the patent, but owing to the increased amount of the first three constituents mentioned, it is proportionately lacking in whiteness and lightness. The two flours each have their advantageous points.

Several other grades of flour, break flour, stone flour, and flours from the first, second, and third tailings, are all very similar, and, as far as chemical analyses is concerned, good. The preliminary examination has, however, shown certain defects in each. The break flour is richer in albuminoids and gluten than any other, and if were pure and its physical condition were good it would be of value.

The roller process is distinguished for the completeness with which it removes the germ of the grain during the manufacture of flour by flattening and sifting it out. This furnishes the three by-products which are known as first, second, and third germ. They consist of the germ of the wheat mixed with varying proportions of branny and starchy matter, the second being the purest. They all contain much ash, oil, and nitrogen, and if allowed to be ground with the flour blacken it by the presence of the oil and render it very liable to fermentation, owing to the peculiar nitrogenous bodies which it carries. A more complete analysis appears in another place.

The flour from the bran-dusters is much like that from the tailings, and like the stone stock, from a chemical point of view. This merely shows that chemical evidence should not alone be taken into consideration, for the bran-duster flour is a dirty, lumpy by-product, while the stone stocks are valuable middlings. Analyses of various tailings are next in the series, and need no comment. Those of the dust from middlings and dust-catchers are rather surprising, in that they both contain much gluten and the first one much fiber, but this is due to their containing both bran and endosperm.

To follow the gluten through the process it is necessary to go back to the breaks. The amount in the various chops does not vary greatly. There is an apparent anomaly, however, in the fifth and sixth breaks, where no gluten was found in the feed but much in the chop. This is owing to the fact that the feed has become at this point in the process so branny that by the usual method of washing to obtain the gluten it does not allow of its uniting in a coherent mass and separating from the bran.

Among the middlings, both uncleaned and cleaned, the fourth is the

richest in gluten, and the result of the process of cleaning is to increase the amount, although slightly diminishing the nitrogen, which is due to the removal of the branny matter, which, though rich in nitrogen, is poor in gluten.

In the products of the reduction on smooth rolls, the chops from the higher middlings are the richest, and if the analyses of the flours were complete, No. 4 would probably contain more than the lower numbers.

The tailings are, as have been already said, remarkable, not so much that No. 1 has no gluten, but that Nos. 2, 3, 4, have 7.62 per cent., and No. 6 as much as 14.37 per cent. The regular increase shows that the highest numbers must contain a large portion of endosperm.

That this is the case the microscopic examination of the different tailings has shown. No. 1 is found to consist almost entirely of the outer coatings of the grain; Nos. 2, 3, and 4 of the same mixed with a large proportion of endosperm, which is attached thereto, while in No. 6 it is difficult to discover any large amount of anything but flouring material, and the small percentage of ash shows also that it cannot contain much bran.

In a like manner No. 4 tailings from the reductions has 13.34 per cent. of gluten, which is owing to the large proportion of endosperm which it contains, and in this case, too, the fact of the presence of so much of the interior of the berry is presaged by the low percentage of ash. The remaining tailings of this class have little or no gluten, with the exception of No. 1, as they contain very little endosperm.

In connection with the remaining specimens the gluten has been already mentioned, and the results as a whole warrant the conclusion that less of it is wasted in the by-products than would be imagined. For a complete discussion of this point data, which are not at hand in regard to the per cent. of each material produced, are necessary.

The products from Virginia wheat, similar to those which have just been described, present the same but not as wide variations in the breaks and in the flours; the low grade, instead of containing less gluten, has more than the bakers' or patent. This may be due to the greater softness of the wheat, in consequence of which it is less suited to the process, a fact which is confirmed to a certain degree by the specimens of flour from Ohio wheat, among which the low grade, although not exceeding the other brands in the amount of gluten, approaches very nearly to them, and it is therefore only reasonable to conclude that the spring wheats are particularly suited for roller milling.

PHOSPHORIC ACID IN THE ASH.

The ash of several samples of wheat and flour have been analyzed. The specimens were selected to represent variations in locality, in hardness, and color, and between winter and spring wheats.

1284. *Champion Amber.*

Pennsylvania; crop of 1879; red wheat.

1288. *Gold Dust.*

Pennsylvania; crop of 1879; yellow wheat.

2001. *No.* 1, *Hard spring.*

Minnesota; crop of 1883; hard red spring, from C. A. Pillsbury & Co.'s mill.

2111. *No.* 1, *Hard spring.*

Dakota; crop of 1883.

2114. *Flour from No.* 1.

Hard spring; Pillsbury "A," best.

Ash analyses of wheats and flours.

	1284.	1288.	2001.	2111.	2114.
	Pennsylvania red.	Pennsylvania yellow.	Minnesota.	Dakota.	Pillsbury "A."
Per cent. of ash	1.63	1.47	1.83	1.88	.409
Insoluble	.067	.025	.049	.027	.004
Phosphoric acid	.796	.729	.828	.888	.203
Potash	.480	.398	.533	.575	.129
Magnesia	.216	.237	.270	.302	.037
Lime	.058	.034	.088	.063	.024
Soda	.15	.046	Trace.	022	.012
Sulphuric acid	Trace.	Trace.	.020	Trace.	.....
Chlorine	Trace.	Trace.	.035	Trace.	.....
Iron	Trace.	Trace.	Trace.	Trace.	.....
Manganese	.....	.....	.005	.....	.....
Per cent. composition of ash.					
Insoluble	4.11	1.70	2.57	1.44	.98
P_2O_5	48.77	49.63	45.35	47.31	49.63
K_2O	29.41	27.09	29 19	30.63	31.54
MgO	13.24	16.13	14.79	16.09	9.05
CaO	3.55	2.32	4.81	3.36	5.87
Na_2O	.92	3.13	Trace.	1.17	2.93
SO_3	Trace.	Trace.	1.10	Trace.	.....
Cl	Trace.	Trace.	1.92	Trace.	.....
Fe_2O_3	Trace.	Trace.	Trace.	Trace.	.....
MnO	.....	.....	.27	.....	.....

The percentage composition of the several ashes include extremely slight variations. The ash of soft wheat contains a little less potash and lime and more magnesia than the ash of the red wheat grown on the same soil, but the variations are too slight for consideration and the composition is quite like the ash of foreign wheat for which Wolff gives the following average:

	Winter wheat.	Spring wheat.
	Per cent.	*Per cent.*
Insoluble	2.11	1.64
P_2O_5	46.98	48.63
K_2O	31.16	29 99
MgO	11.97	12.09
CaO	3.34	2.93
Na_2O	2.25	1.93
SO_3	.37	1.52
Cl	.22	.48
Fe_2O_3	1.31	.51
Undetermined	.29	.28
Total	100.00	100.00
Total ash	1.97	2.14

The conclusions which Von Bibra long ago expressed concerning the wheats which he had examined seem to hold good for this country as well as for Germany. It is only exceptionally that the inorganic constituents of a wheat overstep certain limits, while within them it is liable to frequent variations even on the same field and under otherwise similar conditions.

The analysis of the ash of the flour from Minnesota shows a marked decrease in the percentage of magnesia which it contains, made up principally by an increased amount of lime. Dempwolff's analyses of Hungarian flours gave a similar result. The phosphoric acid, too, is higher, showing that in the interior of the grain, and apparently also in the softer wheats, there is more of this constituent present.

A discussion of the ash constituents of the grain in its different portions will be found in Liebig's Annalen der Chemie, Band CXLIX, S. 345, by Dempwolff. It is quoted by Horsford, in his report on bread at Vienna in 1873, and attention is called to the decrease in percentage of magnesium in the ash of the center of the grain, accompanied by an increase in calcium and potassium, and the fact that phosphoric acid forms about 50 per cent. of the ash. Determinations of the latter constituent in the milling products from Minnesota show that with the hard spring wheats the relative percentage in the ash is higher toward the interior of the grain.*

In the flours as graded for the market the same fact is observed.

RELATION OF NITROGEN TO PHOSPHORIC ACID.

After the consideration of the variations in the ash, it is of interest to observe the relation between the phosphoric acid which it contains and the nitrogen. A column in the table of analyses gives this ratio, expressed as the factor by which the phosphoric acid must be multiplied to equal the nitrogen.

Starting with a ratio of 2.8 in the whole grain, with every purification of the product the figure rises until it reaches the highest grade middlings and patent-flour; that is to say, as we approach the more perfect products there is a greater loss of phosphates than of nitrogen. The highest ratios are found in the patent-flours and in the chop and middlings, which lead directly to this product. In the flours from the reduction of the different grades of middlings the change in the ratio is gradual and corresponds closely to the inverse change in the amount of phosphates in the ash. A high ratio denotes, therefore, a deficiency in phosphates, and this is the chief fault with the high grade flours.

THE GERMS.

One of the characteristic features of the roller-milling process, as has been mentioned, is the removal of the germ of the grain, thus prevent-

* See also Lowe's and Gilbert's paper on the Ash Constituents of Wheat, *Journ. Chem. Soc. XLV*, 305, *Aug.*, 1884, and Appendix of this report.

ing its injuring the quality of the flour. Among the by-products of the Pillsbury mill, are included three separations of germs known as first, second, and third. They are all rich in oil and albuminoids, which together form one-half of the substance. The second germ seems to be freer from contamination and was selected for a more detailed examination.

The following determinations were made:

Analysis of germ.

	Per cent.	Per cent.
Water		8.75
Ash		5.45
Oil		15.61
Soluble in 80 per cent. alcohol	26.45	
Insoluble in water		1.98
Soluble in water	25.47	
Sugar or dextrine		18.85
Non-reducing substance		2.94
Albuminoids		3.65
Soluble in water	4.44	
Dextrine		1.44
Albuminoids		3.00
Starch, &c., undetermined		9.95
Fiber		1.75
Insoluble albuminoids		26.60
		100.00

The interest of the analysis centers in the presence of so much sugar and soluble albuminoids. The sugar has been calculated to percentage as if it were dextrose. It does not reduce Fehling's solution until inverted by acids. It is dextro-rotatory, by inversion becoming less so, but not laevo-rotatory. It is uncertain whether it is formed from starch which may be present through the action of some ferment in the germ; but it seems probable, especially since so much soluble nitrogen is present pointing to diastatic action, and it may be classed somewhere between dextrine and maltose. In fact it has been found that the water extract if left in contact with the residue of the germ would soon be the cause of a peculiar fermentation. This shows the bad effect the presence of this soluble albuminoid would have in flour, causing a fermentation or putrefaction which would injure and discolor it. The oil in the germ is also an additional source of trouble, in that it is readily oxidized under certain circumstances and tends to blacken the flour.

THE RELATIONS OF THE WHEAT GRAIN AND ITS PRODUCTS TO THE HUMIDITY OF THE AIR.

In the report of W. H. Brewer on the cereals, in Vol. III of the Census for 1880, he gives the results of certain experiments by Hilgard, of California, showing the changes in weight of wheat, when exposed to alternations of dry and moist air; California wheat, being particularly dry as it comes from the hot valleys where it grows, absorbs a large amount of moisture in the seaports, or during transportation by sea. Brewer

extended these experiments to all the cereals, and weighing them at intervals found that under the conditions which he employed they without exception lost about the same amount from summer to winter that they would gain from winter to summer, and that when artificially dried and again exposed to the air, a few minutes would suffice for the absorption of several per cent. of moisture.

The importance commercially of this capacity for absorbing or losing moisture is of course apparent, and experiments were undertaken before the appearance of Brewer's report for a more thorough investigation of the subject, in reference especially to mill products.

The materials were exposed in the balance-room of the laboratory of the department properly protected by a screen from exterior influences other than atmospheric. The condition of the atmosphere was noted by means of a psychrometer at the time of weighing.

The first series consisted of a number of flours from Minnesota, all milled by the roller process from hard spring wheats. Three of the five contained nearly 8 per cent. of water originally, one a little over 9, and one over 13. The first day of exposure was comparatively dry for the climate of Washington, but evidently moist as compared to the localities from which all the flours but one had come, because there was a large gain in the part of three, a small gain by the Pillsbury "A," and a loss by the only one holding originally a large amount of moisture; in fact, the result was an approximation to equalization of moisture in all, as would be expected. If we add the gains and subtract the losses the figures, though not representing actual percentages, would appear for moisture as follows, on the second day:

Number.	Original moisture	Gain or loss.	Second day.
2114	9.48	+.65	10.13
2115	7.80	+2.15	9.95
2116	7.85	+2.30	10.15
2117	7.97	+2.15	10.12
2120	13.69	−3.28	10.41

The first day's exposure was sufficient, therefore, to equalize the moisture in all the flours, and following them through the succeeding weeks they all appear to be susceptible to the changes in condition of moisture in about the same degree.

A specimen of the whole grain exposed beside the flour proved itself not as susceptible as the finer material, but nevertheless responded to a certain degree to the daily changes in humidity. A tabulation of the results follows:

	Serial number.	Original per cent. of moisture.	March 8.		March 10.		March 11, 8 a. m.		March 11, 3 p. m.		March 12.		March 13.		March 14.	
			Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.
Dry bulb, °Fahr			73°		69°		62°		70°		68°		68°		60°5	
Wet bulb, °Fahr			61°		55°		54°		61°5		60°		54°		(?)	
Relative humidity, per cent			46.4		35.0		56.1		59·0		60.1		34.0			
FLOURS.																
Pillsbury "A," best	2114	9.48	+.65		−1.12		+1.30		+.90		+.95		−2.80		+1.20	
				100.65		99.53		100.83		101.73		102.68		99.88		101.08
Patent Red River	2115	7.80	+2.15		−.73		+1.10		+1.00		+1.05		−2.60		+1.10	
				102.15		101.42		102.52		103.53		104.57		101.97		103.07
Patent Frazee, Minnesota	2116	7.85	+2.30		−.60		+1.10		+1.00		+1.15		−2.70		+1.00	
				102.30		101.70		102.80		103.80		104.95		102.25		103.25
Patent Pembina	2117	7.97	+2.15		−.60		+1.20		+.85		+1.20		−2.75		+1.10	
				102.15		101.55		102.75		103.60		104.80		102.05		103.15
Patent Minnesota	2120	13.69	−3.28		−1.37		+1.20		+.80		+.85		−2.70		+1.10	
				96.72		95.35		96.55		99.35		98.20		95.50		96.60
WHOLE WHEAT.																
Lamoure County, Dakota, spring	2111	9.57					+.26		−.09		+1.25		−.92		−.08	
								100.26		100.17		101.42		100.50		100.42

NOTE.—In this table the figures in the second column of each date represent the weight which 100 lbs. of the original flour would have assumed under the conditions named.

EXPERIMENTS ON THE HYGROSCOPIC RELATIONS OF FLOURS—CONTINUED.

	Serial number.	Original per cent. of moisture.	March 15.		March 17.		March 18.		March 19.		March 20.		March 21.		March 22.		March 24.	
			Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.
Dry bulb, °Fahr.			70°		63°		67°		68°		71°5		69°		68°		67°5	
Wet bulb, °Fahr.			59°		32°		59°		60°		62°		59°		58°		61°	
Relative humidity, per cent.			48.2		42.2		59.5		60.1		55.6		51.8		51.1		66.9	
FLOURS.																		
Pillsbury "A," best	2114	9.48	+ .45		−1.15		+1.50		+ .15		+ .45		−1.05		+ .25		+1.20	
				101.53		100.38		101.88		102.03		102.48		101.43		101.68		102.88
Patent Red River	2115	7.80	+ .55		−1.35		+1.35		+ .15		+ .65		−1.20		+ .30		+1.15	
				103.62		102.27		103.82		103.97		104.62		103.42		103.72		104.87
Patent Frazee, Minnesota	2116	7.85	+ .50		−1.10		+1.50		+ .10		+ .60		−1.20		+ .30		+1.25	
				103.75		102.65		104.15		104.25		104.85		103.65		103.95		105.20
Patent Pembina	2117	7.97	+1.35		−1.00		+1.40		+ .17		+ .50		−1.12		+ .30		+1.20	
				104.50		103.50		104.90		105.07		105.57		104.45		104.75		105.95
Patent Minnesota	2120	13.69	+1.30		−1.00		+1.40		+ .13		+ .42		−1.00		+ .30		+1.20	
				97.90		96.90		98.30		98 43		98.85		97.85		98.15		99.35
WHOLE WHEAT.																		
Lamoure County, Dakota, spring	2111	9.57	+ .26		− .36		+ .75		+ .08		+ .34		− .30		− .08		+ .84	
				100.68		100.32		101.07		101.15		101.49		101.19		101.11		101.95

NOTE.—In this table the figures in the second column of each date represent the weight which 100 lbs. of the original flour would have assumed under the conditions named.

Flours of the same quality being so much alike in their faculty of absorbing moisture, the experiment was made of exposing different grades with the object of learning whether they would be independent in their action. The results in the table show that the starchy patent grade has a rather greater affinity for water than the others, and that the bakers' grade which is the most glutinous has the least.

EXPERIMENTS ON THE HYGROSCOPIC RELATION OF GRADES OF FLOUR.

Name.	Serial number.	Original per cent. of moisture.	March 15.		March 17, 10 a. m.		March 18, 10 a. m.		March 19, 10 a. m.		March 20, 10 a. m.		March 21, 10 a. m.		March 22, 10 a. m.		March 24, 10 a. m.		March 27, 10 a. m.		March 27, 1 p. m.	
			Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.
Dry bulb, ° Fahr			70°		63°		67°		68°		71.5											
Wet bulb, ° Fahr			59°		52°		59°		60°		62°											
Relative humidity per cent.			48.2		42.2		59.5		60.1		55.6		Moist.		Moist		Moist.		Moist		Dry.	
GRADES OF FLOUR.																						
Bakers'	2056	12.18	−.75	99.25	−1.60	97.65	+1.25	98.90	+.38	99.28	+.32	99.60	+6.25	105.85	+.35	106.20	+1.12	107.32	+.40	107.72	−7.35	100.37
Patent	2057	11.48	+.95	100.95	−1.05	99.90	+1.40	101.30	+.45	101.75	+.40	102.15	+5.55	107.70	+.50	108.20	+1.30	109 50	+.30	109.80	−6.18	103.62
Low grade	2058	12.01	−.62	99.38	−1.37	98.01	+1.40	99.41	+.35	99.76	+.30	100.06	+7.10	107.16	+.40	107.56	+1.70	109.26	+.40	109.66	−7.80	101.86

The approximate agreement between the different grades of flour under ordinary conditions being apparent, they were submitted to an atmosphere nearly saturated with moisture; that is to say, they were placed under a bell with a dish of water. They all gained from 7 to 9 per cent. over their air dry weight, but the low grade and patent flour possessed the largest capacity for moisture, the bakers' holding about 2 per cent. less. On removal to dry air this gain was lost in a very few hours, the bakers' losing a proportionately larger amount than the others. Whether it is owing to a larger percentage in gluten in this flour that it gains less and loses more water than others is questionable.

A Minnesota patent exposed in a small desiccator to air saturated with moisture absorbed more than 26 per cent. of its original weight in sixty-four hours, and in one hundred and eight hours, or four days, more than 29 per cent; but at that time a film of mold covered the flour. The determinations at intervals showed the gain to be—

	Grams.
Weight of flour taken	1.0000
Weight after 35 minutes	1.0285
Weight after 18 hours	1.0930
Weight after 22 hours	1.2005
Weight after 42 hours	1.2405
Weight after 64 hours	1.2670
Weight after 92 hours	1.2915

The flours are plainly more susceptible to moisture than the grain owing to their greater comminution. It was found in California that the latter after being artifically dried would absorb 25 per cent. of moisture. Here a flour, although not dried, has absorbed over 29 per cent. of its original weight.

To decide what parts of the grain were able to absorb and retain the most moisture, how far the degree of comminution affected the result, several of the most prominent products of the roller process were treated in the same way as the previous specimens.

	Serial number.	Original per cent. of moisture.	April 1.		April 2.		April 3.		April 5.		April 7.		April 10.		April 12.		April 14.	
			Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.
Dry bulb °Fahr		68°	68°		70.5		72°		69°		70		70°		69°		68°	
Wet bulb °Fahr		55°	56°		60°		58°		55°		57		58°		56.5		60°	
Relative humidity (per cent.)		38.1	42.4		59.7		37.8		35.0		40.0		44.1		41.1		60.1	
MILL PRODUCTS.																		
Entire wheat (80 mesh)	2002	9.07	−.30	99.70	+.50	100.20	−1.00	99.20	−.16	99.04	+.57	99.61	−.05	99.56	−1.05	98.51	+2.83	101.34
Bran (80 mesh)	2017	10.91	+.47	100.47	+2.20	102.67	−.90	101.77	−.15	101.62	+.57	102.19	+.02	102.21	−.11	102.10	+2.17	104.27
Shorts (80 mesh)	2078	10.94	+.03	100.03	+1.05	101.08	−.95	100.13	−.15	99.98	+.62	100.60	−.03	100.57	−.11	100.46	+2.00	102.46
Third germ (80 mesh)	2072	7.68	−.28	99.72	+.90	100.62	−1.30	99.32	−.10	99.22	+.55	99.77	+.08	99.85	−.16	99.69	+2.46	102.15
Patent flour	2114	9.48	−.05	99.95	+1.15	101.10	−1.20	99.90	−.15	99.75	+.63	100.38	+1.17	101.55	−.17	101.38	+1.94	103.32
Bran (coarse)	2017	10.91	−.60	99.40	+.45	99.85	−1.25	98.60	−.15	98.45	+.42	98.87	+.18	99.05	−.15	98.90	+1.78	100.68
Fifth middlings	2028	12.18	−.85	99.15	+.30	99.45	−1.30	98.15	−.20	97.95	+.38	98.33	+.17	98.50	+.17	98.33	+1.79	100.12

EXPERIMENTS ON THE HYGROSCOPIC RELATIONS OF MILL PRODUCTS—CONTINUED.

	Serial number.	Original per cent. of moisture.	May 7.		May 12.		May 13.		May 14.		May 15.		May 19.		May 21.		May 23.	
			Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.
Dry bulb °Fahr.		68°	70.5		70°		70°		72°		72°		74°		75°		77.5	
Wet bulb °Fahr.		55°	62.5		56°		59.5		59.5		58°		65°		64.5		71°	
Relative humidity (per cent.)		38.1	61.5		35.9		50.3		43.7		3.78		59.3		53.7		71.2	
MILL PRODUCTS.																		
Entire wheat (80 mesh)	2002	9.07	+1.65		−2.45		+.65		+.01		−.44		+2.06		−.73		+1.05	
				102.99		100.54		101.19		101.20		100.76		102.82		102.09		101.05
Bran (80 mesh)	2017	10.91	+1.60		−2.47		+.72		−.01		−.50		+2.26		−.95		+1.40	
				105.87		103.40		104.12		104.11		103.61		105.87		104.92		101.40
Shorts (80 mesh)	2078	10.94	+1.37		−2.45		+.70		+.15		−.60		+2.25		−.93		+1.33	
				103.83		101.38		102.08		102.23		101.63		103.88		102.95		101.33
Third germ (80 mesh)	2072	7.68	+1.82		−2.90		+.95		+.11		−.69		+3.33		−1.65		+2.20	
				102.97		100.07		101.02		101.13		100.44		103.77		102.12		102.20
Patent flour	2114	9.48	+1.31		−2.50		+.72		+.02		−.62		+2.14		−.73		+1.01	
				104.63		102.13		102.85		102.87		102.25		104.39		103.60		101.01
Bran (coarse)	2017	10.91	+1.02		−2.50		+.77		+.07		−.61		+2.17		−.75		+1.35	
				101.70		99.20		99.97		100.04		99.43		101.60		100.85		101.35
Fifth middlings	2028	12.18	+1.08		−2.43		+.68		+.20		−.80		+2.06		−.60		+.94	
				101.20		98.77		99.45		99.65		98.85		100.91		100.31		100.94

EXPERIMENTS ON THE HYGROSCOPIC RELATIONS OF MILL PRODUCTS—CONTINUED.

	Serial number.	Original per cent. of moisture.	May 24.		May 26.		May 29.		June 5.		June 7.		June 10.		June 12.		June 27.	
			Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.	Gain or loss.	Weight of original 100 lbs.
Dry bulb °Fahr	.....	68°	78.5	.....	74.5	.....	68°	.....	80°	.....	75°	.....	77.5	.....	75°	.....	73°	.....
Wet bulb °Fahr	.....	55°	73.	.....	67.5	.....	54.5	.....	65°	.....	69°	.....	71.5	.....	71°	.....	61°	.....
Relative humidity (per cent.)	.....	38.1	75.7	.....	67.9	.....	36.0	.....	40.7	.....	72.4	.....	73.3	.....	81.2	.....	46.4	.....
MILL PRODUCTS.																		
Entire wheat (80 mesh)	2002	9.07	+1.47	.....	−1.12	.....	−3.40	.....	+1.52	.....	+2.68	.....	+.90	.....	+.45	.....	−3.77	.....
				102.52		101.40		98.09		99.52		102.12		103.02		103.47		99.70
Bran (80 mesh)	2017	10.91	+2.00	.....	−1.80	.....	−3.48	.....	+1.48	.....	+3.30	.....	+1.28	.....	+.37	.....	−4.95	.....
				103.40		101.60		98.12		99.60		102.90		104.18		104.55		99.60
Shorts (80 mesh)	2078	10.94	+1.77	.....	−1.49	.....	−3.61	.....	+1.41	.....	+3.32	.....	+1.18	.....	+.40	.....	−4.88	.....
				103.10		101.63		98.02		99.43		102.75		103.93		104.33		99.45
Third germ (80 mesh)	2072	7.68	+2.90	.....	−2.95	.....	−4.56	.....	+1.47	.....	+5.19	.....	+1.65	.....	+.25	.....	−7.20	.....
				105.10		102.15		99.59		99.06		104.25		105.90		106.15		98.95
Patent flour	2114	9.48	+1.22	.....	−0.90	.....	−3.40	.....	+1.60	.....	+2.30	.....	+.75	.....	+.33	.....	−3.28	.....
				102.23		101.33		97.93		99.53		101.83		102.58		102.91		99.63
Bran (coarse)	2017	10.91	+1.76	.....	−1.56	.....	−3.47	.....	+1.45	.....	+3.10	.....	+1.17	.....	+.35	.....	−4.73	.....
				103.11		101.61		98.14		99.59		102.69		103.86		104.21		99.48
Fifth middlings	2028	12.18	+1.20	.....	−.90	.....	−3.22	.....	+1.52	.....	+2.30	.....	+.75	.....	+.30	.....	−3.35	.....
				102.14		101.24		98.02		99.52		101.84		102.50		102.89		99.54

The coarser products absorbed less moisture than the finer, at least where there was a marked change, and among the fine material there was less difference than might be expected. The germ after more than two months' exposure seemed to have accumulated more water than any other, but a rather dry atmosphere, with the thermometer at 73° F. on the 27th of June, brought the whole series below their original degree of moisture. A fresh portion of the germ exposed for a few days for comparison with that which had been weighed out longer, rapidly reached a point even in excess of the latter, it being fresher and not caked so much together. The gains and losses were as follows:

No. 2072.

May 24, 1.30 p. m	102.88
May 24, 2.30 p. m	103.18
May 26, 10 a. m	103.93
May 28, 10 a. m	104.83
May 29, 10 a. m	99.28
June 5, 10 a. m	100.83
June 9, 10 a. m	106.13
June 10, 10 a. m	107.69

and then left in the balance case with a dish of sulphuric acid for forty-eight hours:

June 12	104.05

and over chloride of calcium in a desiccator forty-eight hours:

June 14	96.38

or nearly dry.

The results are instructive, and show how susceptible all portions of the wheat grain, in whatever state of comminution, are to hygroscopic conditions, and it will be noticed, as was found by Brewer, that in summer the amount of moisture held by grain is larger than in winter.

FLOURS.

The analyses of flours given in a previous bulletin having proved unsatisfactory to the millers of the Northwest, they furnished the Department with a series of selected samples of the best Minnesota and Dakota "patents." These, together with an Ohio, and a District of Columbia "patent flour," obtained directly from the millers, have been analyzed.

AMERICAN FLOURS OF 1883.

	1856.	2100.	2057.	2114.	2115.	2116.	2117.	2118.	2119.	2121.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Water	12.32	12.98	11.48	9.48	7.80	7.85	7.97	7.64	8.11	11.33
Ash	34	.32	.39	.39	.42	.42	.45	.42	.52	.91
P_2O_5	.18	.16	.21	.26	.27	.23	.23	.26	.32	.48
Nitrogen	1.71	1.60	2.07	1.99	2.02	1 99	1.88	2.13	2.16	2.18
Albuminoids	10.68	9.98	12.95	12.43	12.60	12.43	11.73	13.30	13.48	13.65
Moist gluten	35.52	29.55	.....	36.14	41.05	40.82	35.20	36.60	44.85	36.73
Dry gluten	10.76	9.08	.....	10.85	11.74	11.81	10.58	11.11	12.59	12.03

1856 Patent Flour, Warder & Barnett, Springfield, Ohio.
2100 Patent Flour, Herr & Cissel, Georgetown, D. C.
2057 Patent Flour, C. L. Pillsbury, Minneapolis, Minn.
2114 Patent Flour, Pillsbury "A," best, Minneapolis, Minn.
2115 Patent Flour, Red River Roller Mills, Fergus Falls, Minn.
2116 Patent Flour, R. L. Frazee, Frazee City, Minn.
2117 Snow Cloud, Pembina Mill Co., Pembina, Dak.
2118 Fargo's Best, Fargo Roller Mills, Fargo, Dak.
2119 No. 1 Straight, Fargo Roller Mills, Fargo, Dak.
2121 Patent Flour, George Davis, Ottawa, Minn.

The Eastern flour is poorer in nitrogen and gluten than any of the others. In fact the flours follow closely the composition of the wheat, which has been examined from the same parts of the country. Dakota makes a flour richer than any other in gluten in the same way that it produces a wheat of that description. The sample from Pembina, like the wheat from that locality, is lower than any other spring wheat flour. The average of these "Northwestern spring wheat flours," is high and in comparison with the rest of the country they are the richest which have been analyzed. They compare favorably with Hungarian roll flour, which they closely resemble.

AVERAGE COMPOSITION OF FLOURS.

	Forty-nine flours, U. S. Census.	Eight Eastern flours.	Minnesota and Dakota flours.
	Per cent.	*Per cent.*	*Per cent.*
Water	11.56	12.49	8.96
Ash	.59	.55	.44
Undetermined albuminoids	11.90	10.41	12.82

Another peculiarity of the spring wheat flours is their dryness. It will be seen in the averages that they contain several per cent. less moisture than the Eastern specimens. From the results of the experiments on the relations of such material to atmospheric conditions it is plain that they would gain weight on transportation east or to the coast, and other things being equal, a barrel of dry Western flour would make more bread than a barrel of Eastern. This is certainly an important factor in the consideration of the value of flours. In specimens Nos. 2057 and 2121 the absorption had, to a large extent, taken place, while the others, being tightly boxed, were received without any absorption.

How readily this would have taken place had an opportunity occurred, will be seen in the analyses of the flours used for baking.

In the light of the preceding analyses there seems to be no reason to doubt but that the introduction of the roller-milling process and the growth of the hard wheats of the Northwest has furnished the country with a finer flour than it has before possessed, and one which should make a bread comparing favorably with Hungarian manufacture. In fact in the baking experiments the bread made from these flours excelled all others in quality.

The flours which have just been mentioned as used for experimental baking purposes have been so far examined as to determine the percentages of water, nitrogen, and albuminoids, and moist and dry gluten. The results are here collected.

ANALYSES OF FLOURS USED IN BAKING.

Variety.	Serial number.	Water.	Nitrogen.	Albumen.	Gluten.	
					Moist.	Dry.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Maryland patent	2593	11.55	1.65	10.33	33.32	9.60
Maryland straight	2800	11.08	1.75	10.94	32.49	10.28
Maryland low-grade	2808	12.78	1.84	11.50	30.15	11.13
District Columbia patent	2821	12.98	1.46	9.10	31.58	9.09
District Columbia straight	2820	12.38	1.53	9.56	33.40	9.76
Virginia straight	2591	12.16	1.93	12.08	36.07	11.41
Virginia low-grade	2807	11.77	2.02	12.60	36.81	11.60
Virginia patent	2805	12.10	1.73	10.81	37.89	11.08
Ohio patent	2190	12.85	1.70	10.62	29.63	10.47
Indiana patent	2822	12.33	1.59	9.94	33.60	10.03
Illinois patent	2594	12.00	1.93	12.08	37.36	11.56
Wisconsin straight	2801	12.37	1.60	9.98	28.39	9.56
Wisconsin patent	2806	13.25	1.85	11.55	34.45	10.65
Minnesota patent	2592	12.82	1.90	11.90	39.18	11.98
Minnesota low-grade	2599	12.05	2.51	15.64	34.22	14.06
Minnesota bakers'	2805	11.77	1.95	12.19	36.71	11.71
Missouri patent	2804	12.04	1.67	10.44	32.24	9.23
Oregon new process	2824	14.03	1.15	7.18	20.84	6.75

They are remarkably uniform in albuminoids and gluten, and also in moisture, showing that they had, with the exception of the Oregon flour, been subjected to very similar hygroscopic conditions. The flours from Minnesota have, without doubt, gained moisture since they were originally milled, if it is possible to judge from previous analyses of samples sent directly from the mills. For this reason, in our bread experiments with this collection of flours, less variation in yield was found than if they had been used directly from the mill with wider variations in their per cent. of moisture.

Among them all two present peculiarities worthy of notice. The Oregon new-process flour contains 7.18 per cent. of albuminoids, the smallest amount yet found in the course of analysis. In this respect it corresponds to Oregon wheat, and confirms the remarks thereon on a previous page. On the other hand the Minnesota low grade contains

more albuminoids and gluten than any heretofore examined. This would not only be remarkable for any flour, but is still more so for one of low grade. How it was graded is unknown. It makes a very dark bread.

BAKING EXPERIMENTS WITH FLOURS FROM VARIOUS SOURCES.

The experiments of the McDougall Brothers in London, in the autumn of 1882, upon the baking qualities of flour made from wheats in the English market from different parts of the world, have had a wide circulation. The statistician of this Department in his report upon the condition of the crops for December, 1883, mentions and quotes them as follows:

EXPERIMENTS IN BREAD-MAKING.

In the autumn of 1882 the secretary of state of India arranged with McDougall Brothers, millers and bakers, London, to conduct a series of experiments with wheats from India in comparison with average samples of wheat from the principal countries producing this grain. Of the conditions required by the secretary they say:

"1. That we should take a given quantity of each of these four representative Indian wheats, viz., Indian fine soft white, Indian superior soft red, Indian average hard white, Indian average hard red, and manufacture them into flour by the ordinary process of grinding under millstones. Also that we should take similar quantities of the same wheats and manufacture them into flour by means of crushing between rollers, according to the system known as the Hungarian or roller system. 2. That we should take a given quantity of each flour so produced and manufacture it into bread. 3. That we should note the qualities and other characteristics of the flours produced, also of the offals, viz., middlings, pollard, and bran. 4. That we should procure the following representative wheats, of fair average quality of the season, as then being sold on Mark Lane market, and, for the purpose of obtaining results for comparison, deal with them precisely as above indicated, both as regards flour, bread, and offals, viz., English average, American (red winter), American (spring), Australian average, California average, Russian Saxonska, Russian Taganrog, Russian Kubanka, Russian Ghirka, Egyptian Buhi, and Egyptian Saida."

The quantity used in each case was 5,000 pounds. The samples varied in weight from 57½ pounds for the Saida Egyptian to 64 pounds for the soft Indian white variety. The weight of the separate "berries" varied greatly; those of American spring were smallest of all, 100 weighing 35.5 grains; winter, 49.6 grains; California, 47.7 grains. The Australian were heaviest, 80.5 grains; Indian, from 51.8 to 77.7 grains. The Saxonska Russian was 37.3 grains, next to American spring the smallest, and containing the most gluten, 23.2 per cent.; yet the size appears to be no indication of the proportion of gluten in other samples, as the heaviest, the Australian, averaged 11.6 per cent., and the poorest in gluten, bearing only 4.4 per cent., was of medium weight, 50.1 for 100.

Wheat.	Value in London per 496 pounds. Net weight on day of valuation.	Weight per bushel.	Impurities removed.	Water absorbed to render mellow.	Yield.				Evaporation and loss.	Gluten by water tests.
					Flour.	Middlings.	Pollard.	Bran.		
	S. d.	*Lbs.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
Indian (fine soft white)	49 0	64	1.52	2.0	77.46	0.82	8.8	12.0	1.40	6.4
Do	49 0	64	1.52	2.0	74.10	11.00	8.7	4.0	2.68	6.8
Indian (superior soft red)	45 0	62¾	0.72	3.6	78.40	1.68	9.8	9.4	3.6	9.3
Do	45 0	62¾	0.72	3.6	75.4	7.7	13.5	5.3	.98	10.5
Indian (average hard white)	44 0	60	3.7	8.4	80.52	.78	10.0	8.3	5.1	11.7
Do	44 0	60	3.7	8.4	73.2	10.3	14.3	3.1	3.8	12.6
Indian (average hard red)	43 0	61¼	1.2	7.6	79.88	.78	13.20	8.50	4.04	13.4
Do	43 0	61¼	1.2	7.6	74.2	10.3	13.8	3.0	5.1	13.1
English	49 0	60½	1.5	None.	65.2	1.1	9.7	17.7	4.8	10.6
Do	49 0	60½	1.5	None.	70.3	7.6	7.2	9.2	4.2	11.4
Australian	50 6	62¼	1.0	None.	75.8	1.1	7.4	14.4	.3	11.6
Do	50 6	62¼	1.0	None	75.1	8.0	9.3	5.5	1.1	12.2
New Zealand	48 0	62¾	.3	None.	76.1	.96	8.8	11.5	2.34	10.2
Do	48 0	62¾	.3	None.	76.1	7.8	6.6	5.6	3.6	9.0
California	48 0	59½	1.7	None.	71.1	.72	9.2	15.3	1.98	10.5
Do	48 0	59½	1.7	None.	70.1	14.5	6.3	3.9	3.5	8.7
American (winter)	49 6	61¾	.5	None.	73.8	.38	7.9	16.4	1.02	11.0
Do	49 6	61¾	.5	None.	71.5	10.3	11.2	3.1	3.4	11.7
American (spring)	48 0	61	.9	None.	72.2	.24	7.2	14.7	4.76	15.3
Do	48 0	61	.9	None.	69.5	12.1	10.4	3.8	3.3	14.6
Russian (Saxonska)	52 0	60½	.9	None.	73.0	1.2	11.6	12.6	.7	22.1
Do	52 0	60½	.9	None.	71.4	12.5	11.7	3.3	.2	23.2
Russian (hard Taganrog)	49 0	61¼	.8	2.4	76.2	1.2	12.7	8.1	3.4	17.6
Do	49 0	61¼	.8	2.4	72.0	9.6	12.1	5.0	2.9	15.6
Egyptian (Buhi)	47 0	58	2.7	3.1	72.9	1.0	11.0	10.0	5.5	4.4
Do	47 0	58	2.7	3.1	72.6	10.4	8.5	3.5	5.4	7.9
Egyptian (Saida)	43 6	57½	12.1	2.7	66.9	.76	11.4	7.5	4.04	7.5
Do	43 6	57½	12.1	2.7	67.8	7.2	6.5	4.9	4.2	6.6

It will be seen that there were fewest impurities in the New Zealand, Indian soft red, American, and Russian samples.

The manufacture of bread from Indian wheats by the millstone and also the roller process, and from other samples by the roller method, was next undertaken. The quantities used in each case were 280 pounds of flour, 30 pounds of liquid potato ferment, one pound of French yeast, and 3½ pounds of salt. The table is as follows:

Wheat.	Water used.	Yield of bread when cold.	Percentages.		Color, taste, and texture.				
			Percentage of bread to flour.	Percentage of water to flour.	Color, exterior.	Color, interior.	Flavor.	Texture.	General characteristics.
	Pounds.	*Pounds.*							
Indian (fine soft white)	141.4	364.0	130.0	50.5	10	11	7	8	11
Do	149.6	367.5	131.2	53.4	13	13	9	9	12
Indian (superfine soft white)	141.6	372.0	133.0	50.6	8	10	7	9	10
Do	148 0	362.0	129.3	52.3	12	13	9	10	11
Indian (average hard white)	141.0	370.5	132.4	50.8	6	7	7	10	7
Do	149.6	365.0	130.3	53.4	10	9	9	10	9
Indian (average hard red)	145.2	376.6	134.5	51.8	5	7	7	10	6
Do	147.4	365.0	130.3	52.2	9	9	8	10	8
English	130.0	352.0	125.7	46.4	13	12	13	10	10
Australian	134.2	355.4	126.9	48.0	12	12	12	10	11
New Zealand	132.0	349.0	124.6	47.1	12	12	12	9	10
California	136.8	364.0	130.0	48.9	12	12	12	9	10
American:									
Winter	130.0	346.0	123.5	46.4	13	12	12	10	11
Spring	130.0	354.0	126.4	46.4	8	10	10	12	9
Russian:									
Saxonska	130.0	356.0	127.1	46.4	8	9	9	13	9
Hard Taganrog	145.4	354.5	126.6	51.9	10	11	9	12	9
Egyptian:									
Buhi	136.8	362.0	129.3	48.9	7	6	6	7	5
Saida	144.4	358.0	127.7	51.6	6	4	4	6	4

Whether the Indian wheats were average samples of the product of that country, or a little better through the unconscious partiality of the secretary, may be questionable. They make a good showing for quantity of product, but the *quality* of the soft wheats is quite inferior to that of samples from this country. In the United States, California appears to take the lead in quantity of bread, while the spring wheats of the Northwest not only surpass other American samples in quality, but are unequaled in that respect by any wheats included in this experiment, the Russian only excepted, which excel in gluten.

The following statement relative to the effect of dryness of the grain upon the yield of bread is extracted from this report:

"It is generally believed that upon the percentage of gluten in flour depends the *yield* of bread that may be obtained from it, as illustrated by the Hungarian flours, which are almost unequaled for yield of bread, and rank high in gluten; but this is erroneous, as proved by the experimental workings now under review. It would be found that the flours high in gluten do not produce the most bread, unless, at the same time, they possess a high degree of *dryness*, for it is upon the dryness of the flour that the yield of bread mainly depends, and not upon the gluten. The two lots of flour from Russian wheats (Nos. 11 and 12) are those which are highest in gluten, yet they do not yield as much bread as any of the four Indian wheats (Nos. 1 to 4), and the difference in yield from the latter would have been still further increased had they not been previously mellowed with water, as noted, before milling; confirming that it is the dryness of a flour that determines the yield of bread."

There being considerable doubt as to whether the samples of American wheats in the preceding experiments were representative, a series of baking experiments with flours of various grades from different parts of this country have been carried on in our laboratory with the results which are presented.

The McDougall Brothers found, and it has been confirmed by us, that upon the dryness of a flour, or upon the amount of water which it is possible to add to the dough, depends chiefly the amount of bread which it will yield. Unfortunately no determinations of the amount of moisture in the flours used was made in the English tests.

In our experiments, using the same flour under various conditions, it was found possible to vary the yield of bread per 100 pounds of flour as much as 15 pounds. The conditions upon which this variation depends are largely physical, and include—

Percentage of water used in the dough.

Size of the loaves.

Temperature of the oven.

Time of baking.

Of course in any series of comparative experiments these conditions must be closely observed and regulated. In order to learn the best modifications for our work, a preliminary series was undertaken with a flour from Ohio.

In the beginning it was found that a dough made with any of our flours and as small a percentage of water as was used by the McDougalls would be altogether too stiff for successful results.

In the English experiments with flours from American wheat 46.4 per cent. of water was used, but in our experience it has been found neces-

sary to add on the average about 56 per cent. of water, or water and milk. The result has been that we have obtained a much larger yield of bread per hundred pounds.

The effects of variation in physical conditions are illustrated by the following data:

Variation in yield dependent on percentage of water used (other conditions being the same), on size of loaves, on difference of temperature, and on time of baking.

[Ohio patent flour.]

Dependent on percentage of water used (other conditions being the same).		Dependent on size of loaves.		Dependent on difference of temperature.		Dependent on time of baking.	
Per cent. of water.	Yield of bread.	No. of loaves.	Yield of bread.	Temperature.	Yield of bread.	Minutes.	Yield of bread.
54.5	134.5	1 loaf.	138.6	249°	136.9	50	134.6
58.4	136.9	10 rolls.	129.6	230°	140.8	30	140.2
62.1	144.9						
62.1	145.5						

In all these cases the yield is largely modified by the change in a single condition, the remaining ones being constant. It is evident, therefore, how complicated a comparative series of experiments becomes when all the above conditions exercise their modifiying effects and must therefore be kept constant.

There are also conditions of mixing and raising which in a like manner affect the yield. As every one knows, there are different methods of carrying out these operations, and larger or smaller amounts of yeast may be used. The method which we have finally employed is a modification of the Vienna procedure as described by Horsford. The dough is mixed in mass with press yeast and allowed to rise till the outer pellicle is just cracking. It is then rekneaded into loaves, put in pans, and set in a warm place until the dough is again risen, when it is baked.

The baking was carried on in a large gas-stove, the oven of which by means of a thermometer could be kept at a very regular temperature. All the materials used and the products obtained were weighed to 1 gramme (15 grains), so that the results as far as manipulation go may be regarded as accurate.

Having fixed these conditions, as they appear in the table which follows, the experiments were conducted with the different flours which have been collected.

RESULTS OF BAKING EXPERIMENTS.

Name of flour.	Serial number.	Experiment number.	Weight of flour.	Weight of milk.	Weight of water.	Weight of salt.	Weight of yeast.	Relation of water to flour.	Raised.	Loss in rising.	Raised in pans.	Baked.	Temperature of oven.	Bread.				Per cent. of moisture.	Per cent. of nitrogen.	Per cent. of albumen.	Gluten.	
														Weight, hot.	Per cent., hot.	Weight, cold.	Per cent., cold.				Per cent. of moist.	Per cent. of dry.
													° C.									
Maryland Patent Flour	2593	18	2,032	500	650	25	10	56.59	2° 35′	12	1° 07′	45′	.....	2,856	140.6	2,729	134.4	11.55	1.65	10.33	33.32	9.60
		31	2,049	500	650	25	10	56.12	3° 00′	30	1° 00′	45′	228	2,933	143.2	2,795	136.4	.....	.....	.....	.....	.....
Maryland Straight	2800	21	2,014	500	650	25	10	57.09	2° 56′	28	1° 06′	45′	.....	2,937	145.8	2,751	136.7	11.08	1.75	10.94	32.49	10.28
		34	2,031	500	650	25	10	56.62	2° 45′	23	1° 00′	50′	248	2,866	141.1	2,746	135.2	.....	.....	.....	.....	.....
Maryland Low Grade	2808	24	2,024	500	650	25	10	56.82	2° 35′	18	55′	45′	243	2,846	140.6	2,740	135.4	12.78	1.84	11.50	30.15	11.13
		37	2,024	500	650	25	10	56.82	2° 45′	32	1° 00′	55′	243	2,859	141.3	2,759	136.3	.....	.....	.....	.....	.....
District of Columbia Patent	2821	43	2,073	500	650	25	10	55.48	2° 30′	59	1° 00′	45′	236	2,873	138.6	2,754	132.9	12.98	1.46	9.10	31.58	9.09
		47	2,056	500	650	25	10	55.93	3° 00′	36	1° 00′	45′	230	2,833	137.8	2,732	132.9	.....	.....	.....	.....	.....
District of Columbia Straight	2820	42	2,045	500	650	25	10	56.23	2° 30′	38	1° 00′	45′	245	2,867	140.2	2,757	134.8	12.38	1.53	9.56	33.40	9.76
		46	2,030	500	650	25	10	56.65	2° 30′	31	1° 00′	45′	235	2,830	139.4	2,730	134.5	.....	.....	.....	.....	.....
Straight Virginia	2591	14	2,033	500	650	25	10	56.57	2° 35′	12	55′	30′	.....	2,948	145.0	.....	.....	12.16	1.93	12.08	36.07	11.41
		16	2,044	500	650	25	10	56.26	2° 41′	19	1° 02′	45′	.....	2,886	141.2	2,792	136.6	.....	.....	.....	.....	.....
		29	2,025	500	650	25	10	56.79	2° 45′	21	1° 00′	45′	248	2,931	144.7	2,808	138.7	.....	.....	.....	.....	.....
Low Grade Virginia	2807	23	2,032	500	650	25	10	56.59	2° 57′	17	1° 15′	45′	247	2,898	142.6	2,785	137.1	11.77	2.02	12.60	36.81	11.60
		36	2,038	500	650	25	10	56.43	2° 10′	28	1° 00′	45′	248	2,870	140.8	2,738	134.3	.....	.....	.....	.....	.....
Roller Patent, Virginia	2805	28	2,034	500	650	25	10	56.54	2° 35′	11	1° 07′	45′	248	2,838	139.5	2,753	134.4	12.10	1.73	10.81	37.89	11.08
		41	2,047	500	650	25	10	56.19	2° 55′	34	1° 00′	45′	230	2,914	142.4	2,781	135.9	.....	.....	.....	.....	.....
Ohio Patent	2190	11	2,149	500	650	25	10	53.51	3° 16′	32	1° 15′	48′	.....	2,986	138.8	.....	.....	12.85	1.70	10.62	29.63	10.47
		12	2,110	500	650	25	10	54.50	.....	24	.....	50′	.....	2,989	141.7	2,810	134.6	.....	.....	.....	.....	.....
Indiana Patent	2822	44	2,049	500	650	25	10	56.12	2° 35′	31	1° 35′	45′	240	2,908	141.4	2,780	135.7	12.33	1.59	9.94	33.60	10.03
		48	2,068	500	650	25	10	55.61	2° 50′	35	1° 00′	50′	230	2,898	140.1	2,772	134.0	.....	.....	.....	.....	.....
Illinois Patent Flour	2594	19	2,041	500	650	25	10	56.35	2° 35′	4	55′	45′	.....	2,914	142.8	2,791	136.8	12 00	1.93	12.08	37.36	11.56
		32	2,043	500	650	25	10	56.29	2° 47′	19	1° 00′	45′	232	2,862	140.1	2,754	134.8	.....	.....	.....	.....	.....
Wisconsin Straight	2801	22	2,035	500	650	25	10	56.51	2° 50′	28	55′	45′	....	2,832	139.2	2,730	134.2	12.37	1.60	9 98	28.39	9.56
		35	2,031	500	650	25	10	56.62	2° 30′	29	1° 00′	45′	245	2,852	140.4	2,728	134.3	.....	.....	.....	.....	.....
Roller Patent, Wisconsin	2806	27	2,034	500	650	25	10	56.54	2° 52′	13	1° 00′	45′	249	2,900	142.6	2,788	137.1	13.25	1.85	11.55	34.45	10.65
		40	2,040	500	650	25	10	56.37	2° 30′	33	1° 00′	45′	234	2,862	140.3	2,745	134.1	.....	.....	.....	.....	.....
Best Minnesota Patent Process	2592	15	2,033	500	650	25	10	56.57	2° 35′	28	55′	30′	.....	2,951	145.2	.....	.....	12.82	1.90	11.90	39.18	11.98
		17	2,028	500	650	25	10	56.71	2° 43′	18	57′	45′	.....	2,825	139.3	2,747	135.5	.....	.....	.....	.....	.....
		30	2,024	500	650	25	10	56.82	2° 30′	23	1° 00′	45′	242	2,802	138.4	2,784	137.6	.....	.....	.....	.....	.....
Minnesota Low Grade	2599	20	2,006	500	650	25	10	57.33	2° 37′	13	1° 00′	45′	.....	2,915	145.3	2,807	139.9	12.05	2.51	15.69	34.22	14.06
		33	2,029	500	650	25	10	56.68	3° 05′	26	1° 00′	45′	234	2,886	142.2	2,786	137.3	.....	.....	.....	.....	.....
Minnesota Bakers'	2803	26	2,024	500	650	25	10	56.82	2° 35′	21	1° 00′	45′	246	2,885	142.5	2,742	135.5	11.77	1.95	12.19	36.71	11.71
		39	2,031	500	650	25	10	56.6.	2° 40′	32	1° 00′	45′	238	2,928	144.2	2,803	138.0	.....	.....	.....	.....	.....
Roller Patent, Missouri	2804	25	2,059	500	650	25	10	55.85	2° 43′	31	1° 00′	50′	248	2,846	138.2	2,738	133.0	12.01	1.67	10.44	32.24	9.23
		38	2,042	500	650	25	10	56.32	2° 45′	39	1° 00′	45′	242	2,859	140.1	2,746	134.5	.....	.....	.....	.....	.....
		45	2,085	500	650	25	10	55.16	2° 40′	41	1° 00′	45′	240	2,873	137.8	2,689	129.0	14.03	1.15	7.18	20.84	6.75
New Process Oregon	2824	49	2,087	500	650	25	10	55.10	2° 30′	24	1° 05′	45′	240	2,883	138.1	2,753	132.0	.....	.....	.....	.....	.....

The results are variable within limits which are so narrow as to make it impossible to say that one flour will make much more bread than another, and it will be observed that the lowest grade gives as large a yield, or even larger, than the best patent. If, however, the moisture in the flour had been less uniform our results would probably show a larger yield of bread for the drier flours. The conclusion must be then that the yield is dependent on physical conditions of bread-making, and not to a large extent upon the chemical composition of the wheat. In all our experiments we get a much larger percentage of bread than the McDougalls, but it is due to the possibility of the use of larger amounts of water in the dough. In other respects their conclusions are confirmed that water is the chief conditioning agent, and that the per cent. of gluten has but little effect upon the yield.

That it has some, however, appears from the fact that the largest yield was obtained with a Minnesota low-grade flour, having the highest gluten of any experimented with, and the lowest yield was from the Oregon flour, having the smallest amount. The bread from the low-grade flour mentioned, although the heaviest yield, was dark and of the worst quality; that from the Oregon flour was white and fair. These flours are very peculiar, and in another place a few remarks are made upon their composition.

Aside from quantity the quality of the bread made from Minnesota patent flours is certainly as near perfect as could be wished. That from other patent flours suffers slightly in comparison, while, of course, the bread from straight flours, bakers', and low grade, cannot compare with that from patents.

CORN (MAIZE).

The average composition of corn from the various States, derived from the analyses published in a previous bulletin, differed very slightly in their percentages of albuminoids. The observations upon this cereal during the past year have been confined, therefore, to determinations of nitrogen and ash in a number of samples from localities from which none had been previously received, and to taking the weights of one hundred kernels of specimens from all parts of the country.

ANALYSES OF AMERICAN CORN BY STATES.

Variety.	Serial number.	Ash.	Albuminoids.	Nitrogen.
New York:		*Per cent.*	*Per cent.*	*Per cent.*
Yellow Flint	2393	1.41	9.80	1.57
Do	2394	1.54	12.43	1.99
Do	2395	1.21	9.28	1.48
Do	2396	1.45	9.10	1.46
Do	2397	1.24	9.45	1.51
Do	2399	1.50	10.85	1.74
Do	2400	1.51	10.68	1.71
Do	2402	1.50	10.85	1.74
Do	2403	1.47	12.43	1.99
Illinois:				
Red Dent	2330	1.27	8.75	1.40
White Dent	2331	1.72	12.08	1.93
Do	2332	1.50	10.68	1.71
Yellow Dent	2333	1.37	10.50	1.68
Do	2336	1.52	11.38	1.82

ANALYSES OF AMERICAN CORN BY STATES—CONTINUED.

Variety.	Serial number.	Ash.	Albuminoids.	Nitrogen.
Illinois—Continued.		*Per cent.*	*Per cent.*	*Per cent.*
White Dent	2337	1.15	8.40	1.34
Red Dent	2341	1.40	10.33	1.65
White Dent	2343	1.36	8.05	1.29
Yellow Dent	2344	2.60	10.33	1.65
Do	2347	1.32	9.28	1.48
Do	2348	1.59	11.38	1.82
Do	2349	1.35	11.20	1.79
Do	2351	1.17	8.40	1.34
Do	2352	1.22	9.80	1.57
White Dent	2353	1.50	10.33	1.65
Yellow Dent	2356	1.85	11.03	1.76
White Dent	2362	1.58	10.33	1.65
Yellow Dent	2365	1.48	10.15	1.62
Red Dent	2366	1.43	7.88	1.26
White Dent	2368	1.30	10.85	1.74
Minnesota:				
Yellow Dent	1989	1.84	10.85	1.74
Do	1990	1.85	12.43	1.99
Do	1991	1.63	11.20	1.79
White Dent	1992	1.39	9.10	1.46
Yellow Flint	1993	1.74	11.03	1.76
Yellow Dent	1994	1.66	9.80	1.57
White Dent	1995	1.51	9.45	1.51
Yellow Dent	1996	1.73	8.75	1.40
Yellow Flint	1997	1.61	9.80	1.57
Yellow Dent	1998	1.65	9.80	1.57
Do	1999	1.66	10.85	1.74
Do	2202	2.02	8.40	1.34
Do	2203	1.57	9.80	1.57
Red Flint	2204	1.49	9.10	1.46
Mixed Dent	2211	1.78	10.50	1.68
White Dent	2217	1.73	10.33	1.65
Dakota:				
White Dent	2307	1.48	10.33	1.65
Red Dent	2308	1.83	11.38	1.82
Yellow Dent	2309	1.88	11.38	1.82
White Dent	2310	1.55	11.03	1.76
Yellow Dent	2311	1.71	10.68	1.71
Do	2312	1.36	9.63	1.54
Do	2313	1.39	11.20	1.79
Mixed Flint	2314	1.35	10.85	1.74
Yellow Dent	2315	1.96	12.25	1.96
Do	2318	1.71	11.03	1.76
White Dent	2320	1.47	10.33	1.65
Yellow Dent	2321	1.47	9.28	1.48
Red Dent	2322	1.03	11.03	1.76
Do	2325	1.84	10.33	1.65
Do	2328	1.51	10.50	1.68
Nebraska:				
Yellow Dent	2371	1.59	10.15	1.62
Do	2373	1.60	10.33	1.65
Do	2374	1.48	9.80	1.57
Do	2375	1.43	10.50	1.68
Mixed Dent	2376	2.01	9.10	1.46
Yellow Dent	2378	1.37	9.45	1.51
Do	2379	1.50	11.90	1.90
Do	2380	1.64	11.55	1.85
Do	2381	1.63	11.73	1.88
Do	2382	1.43	9.63	1.54
Mixed Dent	2385	1.45	9.63	1.54
Yellow Dent	2386	1.40	12.25	1.96
Do	2388	1.51	10.15	1.62
Colorado:				
Yellow Dent	1985	1.92	9.10	1.46
White Dent	1986	3.08	12.25	1.96
Yellow Dent	1987	2.06	9.28	1.48
Do	1988	1.85	8.93	1.43
California:				
White Flint	2296	1.70	11.73	1.88
Yellow Dent	2297	1.35	9.80	1.57
White Dent	2298	1.80	11.73	1.88
Yellow Dent	2299	1.41	8.40	1.34
White Dent	2300	1.68	11.38	1.82
Yellow Dent	2301	1.46	10.68	1.71
Mixed Dent	2302	1.59	9.63	1.54
White Dent	2303	1.54	9.63	1.54
Do	2304	1.58	10.33	1.65
Do	2305	1.63	9.80	1.57
Yellow Dent	2306	1.45	9.80	1.57

ANALYSES OF CORN FROM OTHER SOURCES THAN THE DEPARTMENT OF AGRICULTURE, ARRANGED BY STATES.

Name.	Variety.	Date.	Water.	Ash.	Oil.	Carbhydrates.	Fibre.	Albuminoids.	Nitrogen.	Analyst.
Massachusetts:			*Per cent.*	*Per cent.*	*cent.*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*	
Waushakum	Flint	.....	13.05	1.29	4.06	69.80	1.11	10.69	1.71	United States Census.
Wheeler's Prolific	....do	.....	12.69	1.39	4.58	67.46	1.82	12.06	1.93	Massachusetts Rep't, 1879.
Clark	....do	.....	12.12	1.64	4.75	66.91	2.46	12.12	1.94	Do.
Tip	....do	.....	8.86	1.57	5.26	68.93	2.53	12.85	2.06	Do.
Canada	....do	.....	13.44	1.27	4.56	66.31	2.40	12.02	1.92	Do.
Canada Dutton	....do	.....	14.36	1.42	5.00	66.51	2.38	10.33	1.65	Do.
Massachusetts Red	....do	.....	11.95	1.10	3.40	69.47	2.02	12.06	1.93	Sharples.
Massachusetts White	....do	.....	10.22	1.44	3.40	74.24	1.47	9.22	1.48	Do.
Early Southern	Dent	.....	12.97	1.64	4.83	66.62	2.41	11.54	1.85	Massachusetts Rep't, 1879.
Golden Eight-rowed	Uncla	.....	12.51	1.58	4.94	69.37	1.35	10.25	1.64	Sharples.
Connecticut:										
White Pop-corn	Flint	1876	11.84	1.24	4.92	71.09	1.22	9.69	1.55	United States Census.
King Philip	....do	.....	15.97	1.35	4.50	66 50	1.37	10.31	1.65	Connecticut Report, 1880.
Common Yellow	....do	.....	15.77	1.26	4.44	67.06	1.47	10.00	1.60	Do.
White	....do	.....	16.82	1.19	3.89	67.84	1.32	8.94	1.43	Do.
Early Scioto	Dent	.....	15.24	1.28	3.80	69.78	1.59	8.31	1.33	Do.
New York, White, Yellow Pop-corn	Flint	1879	12.55	1.28	4.18	70.49	1.16	10.34	1.65	United States Census.
South Carolina, Southern White	....do	.....	9.86	1.37	4.48	69.78	2.03	12.47	2.00	Massachusetts Rep't, 1879.
Illinois:										
Western White	Dent	.....	10.77	1.35	4.23	69.72	2.47	11.46	1.83	Do.
Western Yellow	....do	.....	11.90	1.41	4.46	68.39	2.95	10.89	1.74	Do.
	Unclassified	.....	13.61	1.35	3.62	69.10	3.13	9.19	1.47	Sharples.
Minnesota, Yellow Dent	Dent	.....	12.14	1.63	4.25	70.86	1.62	9.50	1.52	United States Census.
New Mexico:										
White	Unclassified	1879	10.92	1.58	5.59	70.10	1.75	10.06	1.61	Do.
Red	....do	1879	10.85	1.60	5.89	68.97	1.60	11.09	1.77	Do.
California, Yellow Dent	Dent	1879	11.42	1.37	5.18	69.16	1.56	11.31	1.81	Do.
Unclassified:										
Western corn	Unclassified	.....	20.68	1.19	3.70	64.95	1.65	7.83	1.25	Connecticut Report, 1880.
Do	....do	.....	20.22	1.16	3.55	64.86	1.67	8.54	1.37	Do.
Do	....do	.....	16.41	1.25	3.85	68.16	1.76	8.57	1.37	Do.
Kansas corn	....do	.....	11.34	1.07	4.60	72.90	1.28	8.81	1.41	Sharples.
Sweet corn:		.....								
Blue Texas	Massachusetts		7.74	1.60	8.70	65.54	2.56	13.86	2.22	Massachusetts Rep't, 1879.
Crosby	....do	....	10.50	1.77	6.91	66.75	2.47	11.60	1.86	Do.
Sweet	Connecticut	1877	10.09	2.08	8.22	61.78	2.52	15.31	2.45	Connecticut Report, 1878.
Burr's Sweet	Sweet	.....	10.68	2.22	7.77	62.70	4.94	11.69	1.87	Sharples.

AVERAGE COMPOSITION OF AMERICAN CORN.

	Ash.	Albuminoids.	Nitrogen.	Number of analyses.	Lowest albuminoids.	Highest albuminoids.
	Per cent.	*Per cent.*	*Per cent.*		*Per cent.*	*Per cent.*
America, 1882	1.52	10.46	1.67	114	7.00	13.05
America, 1883	1.58	10.31	1.65	88	7.88	12.63
Average	1.55	10.39	1.66	202	7.00	13.65
New York	1.43	10.54	1.69	9	9.10	12.43
Illinois	1.48	10.06	1.61	20	7.88	12.08
Minnesota	1.68	10.07	1.61	16	8.40	12.43
Dakota	1.57	10.75	1.72	15	9.28	12.25
Nebraska	1.54	10.47	1.68	13	9.10	12.25
Colorado	2.23	9.89	1.58	4	8.93	12.25
California	1.56	10.26	1.64	11	8.40	11.73

Among the determinations of the ash and nitrogen in the crop of 1883, given in the preceding tables, there is as little variation as in previous analyses, and the conclusions derived from the latter are confirmed.

The average of all the determinations for each year and for both together vary only in the hundredths of a per cent.

Corn may be said, therefore, without doubt, to be very constant in its composition within narrow limits.

An occasional exception will no doubt appear, as is the case of the ash in serial No. 1986, from Colorado, which rises to 3.08 per cent., but among over two hundred analyses this is hardly remarkable.

The averages for the States, as would be expected, agree well. Colorado is represented by only four specimens, which happen to be below the average, while California, represented by eleven, raises the average for the Pacific slope, which, in the previous report, after the analyses of two specimens from Oregon, appeared very low.

Such analyses by other investigators as have been collected since the appearance of the last bulletin on this subject appear here in a table by themselves. The results there given coincide with our own.

WEIGHT OF KERNELS OF CORN IN DIFFERENT PORTIONS OF THE COUNTRY.

Previous results showed that corn varied in weight from 53 grains per hundred kernels to 23 grains, averaging about 37. How far locality and surroundings influenced this has been to a degree determined by the examination of specimens collected by the agents of the Department from all parts of the Union. The results are here tabulated:

CORN, WEIGHT OF 100 KERNELS.

State and county.	Serial number.	Variety.	Color.	Weight.
				Grams.
Maine:				
Cumberland	11	Flint	Yellow	41.7080
Franklin	12	do	do	21.3015
Kennebec	2	do	do	29.9492
Knox	13	do	do	37.0640
Lincoln	4	do	do	23.4490
Waldo	15	do	do	29.4690
New Hampshire:				
Coos	8	Flint	Yellow	17.7670
Vermont:				
Chittenden	12	Flint	Yellow	30.1690
Grand Isle	9	do	do	26.6350
Massachusetts:				
Barnstable	5	Flint	Yellow	46.9374
Berkshire	8	do	do	28.7824
Bristol	11	do	White	51.7450
Franklin	2	do	Yellow	31.6586
Hampshire	12	do	do	37.0370
Connecticut:				
Hartford	5	Flint	Yellow	37.6470
New York:				
Albany	6	Flint	Yellow	23.3870
Alleghany	7	do	do	28.4944
Cattaraugus	31	do	do	28.0286
Chenango	58	do	do	27.8850
Do	58*a*	do	do	23.6990
Cortland	37	do	do	25.0720
Delaware	38	do	do	37.0530
Do	38*a*	do	do	26.9430
Dutchess	13	do	do	33.5348
Fulton	21	do	do	23.5986
Greene	41	do	do	32.4170
Herkimer	10	do	do	18.6986
Jefferson	59	do	White	40.7960
Niagara	29	do	Yellow	34.3590
Oneida	26	do	do	28.7130
Ontario	17	do	do	22.2445
Orange	32	do	do	39.2240
Orleans	46	do	White and red	30.9220
Oswego	15	do	Yellow	21.3620
Queens	48	Dent	Mixed	33.3200
Do	48*a*	Flint	Yellow	43.1110
Saratoga	28	do	do	25.9930
Steuben	25	do	do	39.1112
Tioga	30	do	do	33.6786
Warren	8	do	do	34.5152
Washington	55	do	do	32.4880
Do	55*a*	do	White and red	29.8690
Yates	19	do	Yellow	35.9108
Pennsylvania:				
Beaver	35	Dent	Streaked	40.1450
Bradford	37	Flint	Yellow	35.6170
Centre	41	Dent	do	32.8630
Clinton	42	do	do	31.8490
Columbia	43	do	do	33.3530
Delaware	45	do	do	27.4900
Indiana	49	do	do	41.3560
Do	49*a*	do	Reddish yellow	39.5540
Lawrence	51	do	Yellow	34.2990
Lebanon	52	do	do	38.4480
Luzerne	53	Flint	do	43.7330
Montour	55	Dent	do	33.0520
Northumberland	56	do	Mixed	34.1260
Warren	62	Flint	Flesh	35.9790
York	34	Dent	Mixed	32.8140
New Jersey:				
Camden	4	Dent	Yellow	44.1740
Gloucester	8	do	do	56.6640
Hunterdon	9	do	do	35.7330
Middlesex	10	do	do	38.4360
Morris	12	do	Mixed	46.4710
Salem	14	Flint	Yellow	27.5740
Sussex	15	do	White	46.2980
Maryland:				
Alleghany	1	Dent	Yellow	43.7790
Calvert	4	do	White	34.6020
Do	4*a*	do	do	58.1560
Caroline	5	do	do	34.0010
Carroll	6	do	Yellow	40.0420
Cecil	20	do	do	42.4790

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
Maryland—Continued.				*Grams.*
Charles	7	Dent	White	40.0370
Dorchester	8	do	do	37.4100
Frederick	9	do	Yellow	40.0550
Harford	11	do	do	42.2500
Do	11*a*	do	White	52.5360
Montgomery	21	Flint	do	54.4970
Prince George's	14	Dent	do	43.7740
Somerset	16	do	do	43.1300
Talbot	17	do	do	43.7140
Wicomico	23	do	do	44.7030
Do	23*a*	Flint	do	36.0350
Virginia:				
Albemarle	1	Dent	White mixed	40.3250
Amelia	3	do	Yellow	47.3190
Amherst	4	do	White	40.4620
Do	4*a*	do	do	54.5600
Do	4*b*	do	Mixed	42.6400
Carroll	16	do	White mixed	44.6700
Chesterfield	17	do	White	39.7620
Craig	21	do	White mixed	36.3600
Culpeper	22	do	do	24.1600
Cumberland	23	do	White	42.8920
Dickinson	95	do	do	49.1290
Dinwiddie	24	do	do	36.1750
Elizabeth City	25	do	do	39.7920
Essex	26	do	do	32.6440
Fairfax	27	do	Yellow	36.5730
Floyd	28	do	White	45.0670
Franklin	30	do	do	57.7960
Frederick	31	do	do	56.1340
Giles	32	do	do	47.1150
Goochland	34	do	do	43.6840
Grayson	97	do	do	44.8550
Halifax	37	do	do	45.7640
Hanover	38	do	do	39.2180
Do	38*a*	do	do	31.0440
Henry	40	do	do	40.7340
James City	43	do	do	45.3530
King and Queen	44	Dent and Flint	do	28.0200
Madison	51	Dent	White mixed	43.4240
Matthews	52	do	White	51.1540
Mecklenburgh	53	do	do	45.0450
Middlesex	54	do	do	48.1860
Nansemond	56	do	do	47.8900
Do	56*a*	do	do	38.9440
New Kent	58	do	do	43.9690
Northumberland	61	do	do	52.3760
Orange	63	do	do	47.6080
Patrick	65	do	do	45.0470
Pittsylvania	66	do	Mixed	49.1400
Prince Edward	68	do	White	38.2870
PrinceGeorge	69	do	do	47.7460
Prince William	71	do	do	27.7990
Princess Anne	70	do	do	41.5230
Pulaski	72	do	do	28.7950
Rappahannock	73	do	White mixed	40.5660
Richmond	74	do	White	40.6070
Roanoke	75	do	do	50.9770
Russell	78	do	Yellow and white	46.2350
Smyth	80	do	Flesh	47.9130
Southampton	82	do	White	41.1850
Sussex	85	Dent and Flint	do	40.4520
Tazewell	86	Dent	Yellow	33.6390
Warren	87	do	do	48.8820
Do	87*a*	do	White	47.8720
Warwick	88	do	do	32.6330
Washington	89	do	do	59.7100
Westmoreland	90	do	White mixed	41.4490
West Virginia:				
Barbour	1	Dent	Yellow	40.1420
Berkeley	2	do	do	27.6300
Do	2*a*	do	do	43.5130
Brooke	4	do	do	49.7770
Doddridge	6	do	White	44.9690
Fayette	7	do	do	43.9520
Greenbrier	10	do	Yellow	33.9000
Hancock	12	do	do	31.8860
Hardy	13	do	White	40.0250
Jackson	15	do	Yellow	34.7280

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
West Virginia—Continued.				*Grams.*
Jackson	15*a*	Dent	Yellow	32.6170
McDowell	18	do	White mixed	49.3900
Marshall	20	do	Yellow	45.3850
Mason	21	do	do	41.3260
Mouongalia	24	do	do	44.3150
Monroe	25	do	White	38.4160
Nicholas	27	do	Striped	33.4580
Ohio	28	do	Yellow	38.1590
Pleasants	30	do	do	48.2560
Preston	32	do	do	26.7720
Ritchie	36	do	do	37.4180
Roane	37	do	do	40.3030
Tucker	40	do	do	31.2220
Tyler	41	do	do	36.8050
Wayne	43	do	do	32.6810
Wetzel	45	do	do	42.0710
Wyoming	46	do	do	50.8620
Kentucky:				
Allen	2	Dent	White	41.9820
Barren	4	do	do	47.8830
Butler	98	do	do	43.7350
Casey	100	do	White mixed	45.3870
Clay	16	do	White	60.9090
Clinton	17	do	do	41.4830
Cumberland	19	do	do	37.2330
Do	19*a*	do	do	39.6580
Fayette	22	do	do	36.4460
Floyd	103	do	White mixed	38.2890
Franklin	23	do	do	32.0040
Fulton	104	do	White	36.9570
Gallatin	11	do	do	41.6640
Grayson	28	do	do	48.6780
Hardin	32	do	Striped	42.8270
Harlan	33	do	Mixed	42.8230
Harrison	34	do	Yellow	39.1370
Hopkins	38	do	White	28.0280
Jessamine	39	do	do	45.8660
Knox	42	do	White mixed	46.3940
Laurel	43	do	do	43.2910
Lawrence	44	do	White	35.5860
Lee	108	do	White mixed	43.7520
Letcher	45	do	Yellow	39.5360
Lewis	46	do	do	40.2680
Livingston	48	do	White	41.9730
McLean	51	do	do	33.1090
Madison	52	do	White mixed	52.3770
Do	52*a*	do	Yellow	43.6300
Marion	54	do	Striped	39.1000
Menifee	59	do	White mixed	57.2070
Metcalfe	61	do	White	42.2090
Monroe	62	do	Flesh	48.4790
Muhlenburgh	65	do	White	36.6180
Nelson	66	do	do	44.9670
Nicholas	67	do	do	54.6140
Ohio	68	Flint	do	39.7160
Do	68*a*	Dent	do	46.9460
Owen	70	do	White mixed	36.4080
Owsley	71	do	White	57.0970
Perry	73	do	Flesh	41.2540
Powell	75	do	White	35.5160
Robertson	76	do	do	38.7770
Rock Castle	77	do	White mixed	49.9940
Russell	79	do	Flesh	43.2690
Scott	80	do	White	41.4460
Simpson	112	do	Flesh	42.8850
Spencer	82	do	White	44.9200
Do	82*a*	do	Yellow	40.9050
Trimble	12	do	White	41.3980
Do	86	do	do	52.3830
Union	87	do	do	42.4130
Washington	88	do	do	36.5500
Wayne	89	do	do	34.4170
Woodford	91	do	Yellow	31.6230
Tennessee:				
Anderson	1	Dent	White	48.1260
Bedford	2	do	Yellow	34.9680
Blount	5	do	White	43.5470
Bradley	6	do	do	63.3840
Campbell	7	do	do	49.5090

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
Tennessee—Continued.				*Grams.*
Cannon	8	Dent	Red	44.7720
Carroll	9	do	White	37.3520
Carter	10	do	do	39.9900
Chatham	11	do	Yellow	36.2570
Claiborne	12	do	White	48.7480
Cumberland	16	do	White mixed	41.2220
Davidson	17	do	White	48.6310
Dyer	21	do	do	46.9320
Fayette	22	do	White mixed	38.9430
Fentress	23	do	White and yellow	43.3210
Franklin	24	do	White mixed	50.9990
Gibson	25	do	White	55.6140
Giles	26	do	do	42.1770
Do	26*a*	do	do	64.1020
Grainger	27	do	do	50.8800
Greene	28	do	do	32.9000
Do	28*a*	do	do	48.5940
Hamilton	29	do	do	57.8120
Hancock	30	do	do	38.8760
Hawkins	33	do	do	30.7400
Henderson	35	do	do	37.0890
Henry	36	do	do	31.4500
James	40	do	do	43.6350
Jefferson	41	do	do	52.3530
Lake	44	do	do	61.1410
Lauderdale	45	do	do	29.6330
Lewis	47	do	do	53.5600
Lincoln	48	do	do	42.9770
Loudon	49	do	do	47.2660
McMinn	50	do	do	47.5200
Madison	51	do	do	45.9660
Meigs	54	do	White mixed	48.9620
Monroe	55	do	do	50.3840
Obion	59	do	White	44.3210
Perry	61	do	do	49.7720
Pickett	63	do	do	36.5040
Polk	62	do	do	45.5760
Rhea	65	do	do	48.7750
Robertson	67	do	do	46.6970
Rutherford	68	do	do	37.1160
Scott	96	do	do	47.9150
Sequatchie	69	do	do	34.6750
Do	69*a*	do	do	40.8140
Sevier	70	do	do	51.0940
Shelby	71	do	Red and yellow	42.0800
Stewart	73	do	White	40.5950
Sullivan	74	do	do	46.6280
Sumner	75	do	Yellow	39.2230
Tipton	76	do	Mixed	45.6770
Unicoi	78	do	White	42.9740
Do	78*a*	do	do	43.3720
Warren	81	do	do	49.2900
Washington	82	do	do	44.4180
White	85	do	do	56.4240
Wilson	87	do	White mixed	50.7800
North Carolina:				
Alamance	1	Dent	White	36.8990
Alexander	2	do	do	47.2170
Alleghany	3	do	do	44.0060
Ashe	5	Dent and Flint	do	33.2440
Beaufort	6	Dent	Yellow	47.5080
Bertie	7	do	White	37.8140
Burke	10	do	do	33.2530
Cabarrus	11	do	do	42.7960
Caldwell	12	do	do	31.4350
Carteret	14	do	Yellow mixed	37.6820
Chatham	17	do	White	42.5690
Cherokee	18	do	do	42.0380
Chowan	19	do	do	47.0040
Clay	20	do	do	45.7720
Cleveland	21	do	do	36.6050
Craven	23	do	do	38.9610
Cumberland	24	do	do	35.1720
Currituck	25	do	do	52.4550
Do	25*a*	do	do	59.9280
Duplin	29	do	do	32.2610
Do	29*a*	do	do	47.3880
Edgecombe	30	do	do	41.2440
Forsyth	31	do	do	42.0760

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
North Carolina—Continued.				*Grams.*
Franklin	32	Dent	White	30.1630
Gaston	33	do	Mixed	37.6070
Gates	34	do	White	48.7780
Greene	37	do	White mixed	44.8060
Halifax	39	do	White	54.8920
Harnett	40	do	do	37.6740
Henderson	42	do	White mixed	45.8500
Iredell	43	do	White	35.4980
Jackson	44	do	do	49.1170
Johnston	45	do	do	34.4790
Do	45*a*	do	Mixed	37.1270
Jones	46	do	do	38.8420
Lenoir	47	do	do	41.1470
Macon	50	do	White	44.3440
Madison	51	do	do	50.1250
Moore	56	do	do	37.6320
New Hanover	58	do	do	43.7400
Do	58*a*	do	Yellow mixed	41.6500
Pamlico	61	do	White	44.7080
Pasquotank	62	do	do	40.6100
Pender	63	do	do	30.1470
Polk	66	do	do	44.6580
Randolph	67	do	do	50.8030
Richmond	68	do	Yellow	39.4120
Rowan	70	do	White	43.8960
Rutherford	71	do	do	34.3190
Stokes	73	do	do	55.1340
Surry	74	do	do	48.4200
Swain	75	do	do	60.5360
Transylvania	76	do	do	48.5150
Union	78	do	Mixed	42.2620
Wake	79	do	White	40.3820
Wilkes	82	do	Yellow mixed	44.6350
Wilson	83	do	White	42.1510
Yadkin	84	do	do	42.6170
Yancey	85	do	do	44.6010
South Carolina:				
Aiken	2	Dent	White	37.5570
Barnwell	3	do	White mixed	31.9770
Beaufort	4	Flint	White	27.1930
Charleston	6	Dent	do	27 9010
Clarendon	9	Flint	do	31.5070
Colleton	10	Dent	do	34.9150
Georgetown	14	Flint	do	39.1870
Lancaster	19	Dent	do	24.2640
Lexington	20	do	do	42.4720
Marion	21	do	do	28.7250
Newberry	23	do	White and yellow	34.6620
Oconee	24	do	White	42.2610
Orangeburgh	25	do	do	43.2870
Pickens	26	do	do	54.6680
Richland	27	do	do	46.1000
Spartanburgh	28	do	do	35.5490
Williamsburgh	31	do	do	40.5140
York	32	do	Yellow	43.0170
Georgia:				
Banks	4	Dent	White	37.0870
Do	4*a*	do	do	47.8510
Berrien	6	do	do	34.5660
Brooks	8	do	Mixed	30.6540
Bulloch	10	do	do	35.3600
Campbell	14	do	White mixed	27.0600
Carroll	15	do	White	30.9250
Catoosa	16	do	White mixed	41.1230
Cherokee	21	do	do	40.0660
Clarke	22	do	do	35.0520
Clayton	44	do	White	42.5320
Clinch	25	do	White mixed	34.0820
Cobb	26	Flint	White	25.4800
Coffee	27	Dent	do	41.4550
Colquitt	28	do	do	51.1090
Dawson	33	do	do	39.2370
Dooly	36	do	White mixed	28.9600
Early	38	do	do	30.2580
Effingham	40	do	White	28.6630
Elbert	41	do	White mixed	40.2650
Emanuel	42	do	Mixed	25.1970
Farnin	43	do	White	47.2580
Floyd	45	do	Mixed	40.2010

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
Georgia—Continued.				*Grams.*
Forsyth	46	Dent	White mixed	39.0430
Franklin	47	do	White	63.1250
Fulton	48	do	do	55.4030
Do	24	do	do	37.8450
Gilmer	49	do	do	50.0520
Gordon	50	do	do	52.3280
Gwinnett	52	do	do	47.3600
Habersham	53	do	do	50.2240
Hancock	55	do	White mixed	35.7080
Haralson	56	do	White	56.1570
Hart	58	do	White mixed	42.4550
Heard	59	do	White	43.1120
Henry	60	do	Mixed	43.2460
Jasper	63	do	White	41.2540
Johnson	64	do	do	38.0280
Jones	65	do	White mixed	43.3010
Laurens	66	do	White	31.5020
Liberty	67	do	Mixed	32.6340
Lincoln	68	do	White mixed	37.3860
Lowndes	69	do	do	28.6160
McDuffie	71	do	Mixed	34.8120
Macon	72	do	White mixed	30.3910
Madison	73	do	White	53.9590
Meriwether	75	do	do	46.1660
Montgomery	78	do	do	35.3390
Morgan	79	do	White mixed	38.3160
Muscogee	81	do	White	41.8700
Newton	82*b*	do	White mixed	34.9500
Oglethorpe	84	do	do	34.1580
Paulding	85	do	Mixed	46.0610
Pickens	86	do	White	47.8590
Pierce	87	do	Mixed	33.0200
Polk	88	do	White	47.4460
Quitman	90	do	do	31.4300
Rabun	91	do	do	43.7510
Randolph	92	do	Yellow	33.5490
Schley	95	do	White	29.9720
Spalding	96	do	Yellow	37.3400
Sumter	98	do	White mixed	49.5240
Talbot	99	Flint	White	41.6920
Tattnall	100	Dent	Yellow	33.9970
Telfair	101	do	White	30.0920
Terrell	102	do	White mixed	30.0200
Troup	105	do	White	42.8540
Union	106	do	do	44.9360
Upson	107	do	do	32.9920
Walton	108	do	White mixed	46.9480
Warren	109	do	White	38.7960
Webster	112	do	do	32.1400
White	113	do	do	57.1580
Whitfield	114	do	White and yellow	49.0270
Florida:				
Clay	5	Dent	White	31.2500
Columbia	6	Dent and Flint	Yellow and white	31.1340
Gadsden	8	Dent	White mixed	26.7860
Hernando	10	do	do	28.5960
Jackson	12	do	do	44.1160
Madison	15	do	White	43.1560
Manatee	16	do	Yellow and white	29.6940
Putnam	19	do	Mixed	38.0460
Taylor	22	do	White mixed	27.2250
Alabama:				
Bibb	3	Dent	White	32.9560
Blount	4	do	do	30.5550
Butler	6	do	Mixed	27.1580
Cherokee	9	do	White mixed	40.1277
Chilton	10	do	White	46.9630
Clarke	12	do	Yellow	48.6520
Do	12*a*	do	White mixed	31.9532
Colbert	15	do	do	44.5242
Cullman	18	do	White	35.6457
Dale	19	do	White mixed	32.4954
Dallas	20	do	Mixed	37.9880
Escambia	22	do	do	30.2945
Etowah	23	do	White	41.8220
Fayette	24	do	White mixed	41.3400
Geneva	26	do	White	21.1625
Greene	27	do	Mixed	28.7150
Hall	28	do	White	36.5180

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
Alabama—Continued.				*Grams.*
Henry	29	Dent	White	32.2886
Jackson	30	do	do	46.0700
Jefferson	31	do	White mixed	38.8657
Lamar	32	do	White	37.2571
Lauderdale	33	do	do	56.6144
Limestone	36	do	White mixed	42.8556
Lowndes	37	do	White	33.8680
Madison	39	do	White mixed	49.3930
Marengo	40	do	do	34.1770
Marion	41	do	Mixed	41.8520
Morgan	46	Dent and Flint	White	36.3313
Do	46*a*	Dent	White mixed	51.5800
Perry	47	do	White	40.9950
Pike	49	do	do	22.1005
Randolph	50	do	do	24.6148
Russell	51	do	do	31.5230
Saint Clair	52	do	White mixed	46.5350
Shelby	53	do	do	52.9600
Tallapoosa	56	do	White	35.5350
Washington	58	do	Red	38.7158
Mississippi:				
Alcorn	1	Dent	Yellow	48.9840
Calhoun	4	do	White mixed	35.1310
Carroll	5	do	White	25.9460
Do	5*a*	do	do	48.5970
Choctaw	7	do	White mixed	44.6050
Claiborne	8	do	White	32.0940
Clarke	9	do	Mixed	22.7770
Copiah	10	do	White mixed	39.5290
Greene	13	do	White	39.9570
Hinds	16	do	White mixed	43.2710
Jasper	20	do	White	28.3290
Jefferson	21	do	Yellow mixed	34.3140
La Fayette	23	do	White	55.2550
Lowndes	25	do	Mixed	27.3950
Marshall	27	do	White	49.8310
Neshoba	28	do	Streaked	26.0220
Newton	29	do	White	33.1620
Rankin	34	do	do	31.8600
Scott	35	do	do	37.4090
Simpson	37	do	Streaked	27.2700
Do	37*a*	do	White mixed	31.5678
Smith	38	do	White	30.6740
Tate	40	do	White mixed	39.9880
Tishoningo	42	do	White	43.6680
Union	43	do	do	38.9320
Wayne	44	do	Mixed	30.0850
Webster	45	do	White	40.0700
Wilkinson	46	do	do	33.3670
Winston	47	do	do	26.0300
Louisiana:				
Cameron	7	Dent	Yellow	35.2190
De Soto	11	do	White	28.5780
East Carroll	12	do	do	37.1730
Iberville	15	do	Yellow and white	35.2480
Jackson	16	do	White	15.5040
Jefferson	29	Flint	Yellow	29.4170
Madison	20	Dent	White	33.8530
Natchitoches	22	do	do	39.7050
Pointe Coupée	23	do	do	29.5830
Saint Helena	30	do	Yellow	35.7330
Saint Mary's	32	do	do	36.9630
Saint Tammany	33	do	White mixed	29.6020
Tangipahoa	34	do	Flesh	26.7330
Michigan:				
Barry	28	Dent	Yellow	20.9080
Bay	29	do	do	42.6000
Cass	30	do	do	26.2620
Crawford	31	Flint	White	32.0900
Eaton	33	Dent	Yellow	36.4880
Hillsdale	38	do	do	25.1650
Macomb	44	Flint	do	34.2050
Manitou	45	do	White	42.3580
Missaukee	51	do	Yellow	23.4840
Do	51*a*	do	do	26.8200
Oscoda	55	Dent	Yellow and white	29.7980
Roscommon	75	Flint	Yellow	32.5480
Do	75*a*	do	do	32.9020
Saginaw	58	do	do	35.6920

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number	Variety.	Color.	Weight.
Michigan—Continued.				*Grams.*
Saint Clair	59	Flint	White	33.2850
Shiawassee	61	Dent	Yellow	27.5560
Tuscola	62	do	Red	33.1720
Van Buren	63	do	Yellow	30.4730
Wisconsin:				
Jefferson	30	Dent	Yellow	22.3190
Ohio:				
Adams	1	Dent	White	40.5060
Ashland	6	do	Yellow	34.2802
Ashtabula	46	do	do	34.4770
Carroll	7	do	do	29.8493
Champaign	30	do	do	32.6658
Columbiana	23	do	do	25.3884
Coshocton	37	do	do	31.8665
Defiance	25	do	White	37.4036
Delaware	11	do	Yellow	22.8365
Erie	3a	do	do	21.1618
Fairfield	19	do	Red	27.6386
Fulton	61	do	Yellow	30.9250
Greene	18	do	do	40.4586
Henry	28	do	do	25.9740
Hocking	49	do	do	26.7752
Holmes	10	do	do	43.8076
Huron	90	do	do	33.1150
Jefferson	47	do	do	31.2440
Lawrence	68	do	White	36.4650
Licking	17	do	Red	38.4322
Lorain	69	do	do	28.2750
Lucas	12	do	Yellow	23.4321
Madison	70	do	do	32.0610
Do	70a	do	do	41.5100
Mahoning	71	do	do	33.2640
Marion	72	do	White mixed	35.0260
Medina	45	do	Yellow	36.9214
Meigs	13	do	White	38.3315
Do	13a	do	Red	36.6330
Montgomery	73	do	Yellow	37.5540
Morrow	33	do	do	29.3361
Noble	9	do	do	34.6856
Ottawa	35	do	do	34.0585
Paulding	16	do	do	37.4692
Pike	76	do	White	40.2480
Portage	48	do	Yellow	26.6815
Putnam	29	do	do	34.6350
Richland	27	do	do	32.9336
Ross	15	do	do	28.3966
Sandusky	78	do	do	31.1770
Seneca	20	do	do	34.8586
Shelby	38	do	White	25.2562
Do	5	do	Yellow	23.9230
Stark	31	do	Red	30.2410
Trumbull	81	do	Yellow	27.3670
Tuscarawas	8	do	do	23.2740
Van Wert	83	do	do	26.1070
Vinton	21	do	White	36.6730
Warren	24	do	Red	40.6228
Williams	89	do	Yellow	35.6770
Wood	43	do	do	32.1916
Wyandot	14	do	do	32.6129
Indiana:				
Adams	59	Dent	Yellow	28.1696
Benton	18	do	Yellow and white	22.6528
Blackford	69	do	Yellow	35.3738
Boone	47	do	do	35.2074
Carroll	24	do	do	42.5918
Clark	70	do	Streaked	34.9800
Clay	40	do	White	29.2262
Crawford	10	do	do	22.0645
Dearborn	9	do	Yellow	50.5868
De Kalb	60	do	do	13.8586
Elkhart	73	do	do	28.8760
Fayette	56	do	do	31.5564
Fountain	11	do	do	31.2786
Franklin	74	do	do	35.4210
Fulton	75	do	White	31.3630
Harrison	52	do	Yellow	45.7316
Henry	55	do	do	37.4432
Howard	2	do	Red	39.9674
Huntington	12	do	Yellow and white	30.7252

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
Indiana—Continued.				*Grams.*
Jackson	15	Dent	White	47.7678
Jasper	8	do	Yellow	21.4614
Jay	50	do	do	29.4946
Kosciusko	36	do	White	24.4790
La Grange	38	do	Yellow	27.0386
La Porte	62	do	do	37.9586
Marshall	33	do	do	29.9606
Monroe	49	do	White	37.0898
Montgomery	45	do	Yellow	33.2980
Morgan	1	do	do	51.2106
Noble	22	do	do	31.3866
Ohio	84	do	White	44.9470
Orange	85	do	Yellow	43.3770
Do	85*a*	do	White	35.9280
Parke	87	do	Yellow	34.8950
Porter	46*a*	do	White	34.0074
Pulaski	5	do	Yellow	32.3495
Putnam	48	do	do	30.1016
Ripley	90	do	White	33.7740
Do	90*a*	do	do	31.2960
Rush	44	do	Yellow	36.3008
Shelby	4	do	White	41.9728
Starke	3	do	Yellow	30.5522
Steuben	13	do	White	22.4916
Do	13*a*	do	Yellow	35.4294
Sullivan	43	do	do	32.4928
Switzerland	94	do	White	52.1730
Do	94*a*	do	do	38.4600
Tipton	96	do	Yellow	43.4290
Union	97	do	do	32.9960
Vermillion	19	do	White	40.4894
Wabash	21	do	Yellow and white	35.5470
Wells	5	do	do	19.9096
White	17	do	Yellow	31.0168
Whitley	100	do	do	36.8400
Do	100*a*	do	White	35.2810
Illinois:				
Adams	67	Dent	White	46.3570
Alexander	94	do	do	30.1240
Bond	68	do	do	32.9010
Bureau	95	do	Yellow	35.7732
Champaign	42	do	do	23.3640
Christian	44	do	Red	41.5586
Clay	14	do	Yellow	32.2042
Cook	59	do	do	31.4356
Cumberland	71	do	White	37.5070
De Kalb	8	do	Yellow	28.6136
De Witt	72	do	do	31.1960
Douglass	34	do	White	41.3564
Edgar	49	do	do	41.0110
Effingham	57	do	Yellow	34.2900
Fayette	3	do	White	39.0250
Ford	25	do	do	29.9876
Fulton	57	do	do	31.0780
Gallatin	7	do	do	38.5586
Hancock	50	do	Yellow	36.7812
Jackson	76	do	White	44.7320
Jasper	40	do	Yellow	30.7186
Jefferson	56	do	Red	36.0186
Jersey	15	do	do	30.3520
Jo. Daviess	22*a*	do	Yellow	24.6400
Kankakee	79	do	White	31.5150
Kendall	51	do	Yellow	27.4037
Lake	30	do	do	25.0166
La Salle	41	do	White	42.6040
Lee	21	do	Yellow	33.4286
Livingston	23	do	do	33.7684
McDonough	13	do	do	39.1186
McHenry	20	do	do	32.6980
Do	20*a*	do	White	35.7840
McLean	6	do	Yellow	30.1254
Macon	48	do	do	33.7386
Marshall	52	do	do	26.5058
Mercer	10*a*	do	White	27.8624
Do	11	do	Yellow	40.2412
Monroe	29	do	White	42.4926
Montgomery	55	do	Yellow	42.6406
Ogle	43	do	do	31.1986
Do	43*a*	do	White	30.2512
Peoria	83	do	Yellow	27.7110

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
Illinois—continued.				*Grams.*
Perry	17	Dent	Yellow	29.9728
Pike	84	do	do	41.3440
Pulaski	86	do	White	22.6770
Rock Island	36	do	Yellow	31.5156
Sangamon	88	do	White	46.8000
Schuyler	89	do	Yellow	40.2030
Scott	100	do	White	46.0830
Stephenson	18	do	Red	25.3242
Tazewell	101	do	White	31.6850
Union	102	do	White mixed	39.2440
Vermillion	1	do	Yellow	29.3676
Wabash	45	do	White	33.1156
Warren	75	do	Yellow	31.7960
Do	46	do	do	33.0220
Will	19	do	do	36.3090
Williamson	24	do	White	46.2586
Minnesota:				
Benton	31	Dent	Yellow	21.1542
Big Stone	13	do	do	39.8516
Do	42	Flint	White, yellow, and black	31.3684
Brown	25	Dent	White	22.0909
Carver	35	do	do	25.8165
Do	38	do	Yellow	24.1843
Dakota	16	do	White	24.1786
Douglas	7	Flint	Yellow	41.2822
Fillmore	17	Dent	Red	32.0554
Houston	10	do	Yellow	29.2991
Isanti	19	do	do	19.4474
Jackson	4	do	Red	19.9821
Kandiyohi	24	do	Yellow	19.2792
Lac-qui-parle	10	do	do	19.4693
Martin	30	do	do	26.4604
Do	29	do	White	24.2838
Meeker	28	do	Yellow	24.1566
Morrison	43	do	do	16.2254
Nicollet	12	do	do	26.5099
Nobles	32	do	do	20.7930
Olmsted	33	do	do	17.7810
Otter Tail	22	Flint	do	25.7456
Pipe Stone	26	Dent	White, yellow, and red	24.9243
Pope	36	Flint	Yellow	33.0280
Rice	41	Dent	do	18.3767
Scott	39	do	do	26.7942
Do	39a	do	White	29.7727
Do	40	Flint	Yellow	35.6121
Sibley	5	Dent	do	26.2399
Wadena	49	do	Mixed	17.6820
Washington	44	do	Yellow	25.4284
Watonwan	20	do	do	16.0737
Wilkin	3	Flint	Red	26.7068
Winona	6	Dent	White	27.8001
Dakota:				
Beadle	30	Dent	Yellow	27.8736
Bon Homme	12	do	do	33.5224
Do	43	do	do	32.1690
Charles Mix	5	do	Red	37.2568
Clay	21	do	White	26.3893
Do	32	do	Yellow	28.5002
Do	10	do	do	24.2168
Davison	9	do	White	28.9386
Hughes	36	do	Yellow	25.3156
Hutchinson	25	do	Red	26.5986
Do	17	do	Yellow	22.7064
Jerauld	31	do	Red	19.3602
Lincoln	23	do	Yellow	18.5560
Do	18	do	White	24.7318
Do	11	do	Red	19.7472
McCook	4	do	Yellow	33.4468
Minnehaha	24	do	do	23.4876
Moody	7	do	do	18.5598
Do	8	do	do	25.5314
Morton	14	Flint	White and black	32.1986
Spink	29	Dent	Red	21.5493
Do	16	do	Yellow	23.3092
Stutsman	35	Flint	White	30.6346
Union	7	Dent	Yellow	28.0728
Yankton	27	do	White	30.6512
Do	20	do	Yellow	27.5498

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
Montana:				
Custer	1	Flint	Yellow	*Grams.* 26.5140
Dawson				
Yellowstone				
Iowa:				
Allamakee	3	Dent	Striped	38.6840
Audubon	5	do	White	32.8640
Benton	6	do	do	35.6600
Black Hawk	7	do	Yellow	40.2990
Buchanan	9	do	do	22.9360
Buena Vista	10	do	do	26.8740
Calhoun	12	do	do	23.4840
Cerro Gordo	15	do	White	25.5670
Cherokee	16	do	Yellow	26.4880
Chickasaw	17	do	White	31.4780
Clay	19	do	Yellow	30.3280
Clinton	21	do	do	24.1820
Crawford	22	do	do	27.6350
Dallas	23	do	do	34.6070
Davies	24	do	do	34.3350
Decatur	25	do	White	31.7660
Delaware	26	do	Mixed	35.3040
Dickinson	28	do	Yellow	28.9840
Floyd	32	do	White mixed	25.4180
Greene	35	do	Striped	34.8658
Guthrie	36	do	Streaked	36.4130
Hamilton	37	do	Yellow	37.4300
Henry	40	do	do	29.4160
Humboldt	42	do	White mixed	28.7750
Ida	43	do	Yellow	31.3590
Iowa	44	do	do	28.1080
Jasper	46	do	do	33.5990
Jones	49	do	White	30.0030
Keokuk	50	do	Yellow	43.2980
Lee	52	do	do	34.4640
Louisa	54	do	do	41.8990
Lucas	55	do	do	29.2090
Mahaska	58	do	do	29.1820
Marion	59	do	do	45.3770
Mills	61	do	do	23.6140
Muscatine	65	do	do	35.8070
Poweshiek	73	do	do	37.7270
Sac	75	do	Mixed	31.3899
Sioux	56	do	Yellow	26.6380
Story	78	do	do	35.1920
Tama	79	do	do	29.8040
Van Buren	82	do	White	42.0150
Warren	83	do	Yellow	29.1020
Washington	84	do	do	32.5490
Winneshiek	87	do	do	23.4050
Worth	89	do	do	26.3120
Wright	90	do	do	24.4650
Nebraska:				
Adams	17	Dent	Red and yellow	27.8096
Boone	33	do	Yellow	34.2560
Buffalo	20	do	do	31.3840
Do	21	do	do	43.6348
Do	24	do	do	40.3420
Burt	15	do	do	24.9534
Butler	53	do	do	36.5940
Cass	3	do	Red and yellow	30.9986
Colfax	2	do	Yellow and white	27.0632
Cuming	22	do	Red, yellow, & white	27.2164
Custer	18	do	Yellow	29.3760
Dakota	34	do	do	28.9710
Dawson	35	do	do	33.4270
Dixon	56	do	do	31.8700
Dodge	16	do	do	22.1462
Franklin	58	do	Yellow and white	41.3900
Frontier	59	do	Yellow	37.7530
Furnas	23	do	do	33.9092
Gosper	38	do	do	37.0230
Greeley	12	do	do	24.3986
Hitchcock	61	do	Yellow and white	25.2220
Holt	40	do	Yellow	27.8020
Howard	1	do	White	42.3510
Johnson	6	do	Yellow	33.6380
Do	10	do	do	30.7426
Kearney	25	do	White	32.2800
Do	25a	do	Striped	33.8632

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
Nebraska—Continued.				*Grams.*
Merrick	14	Dent	Yellow	31.4826
Nance	64	do	do	41.4650
Nemaha	4	do	Red	47.2490
Do	4a	do	Yellow	44.0820
Do	4b	do	do	37.0976
Do	4c	do	White	45.1110
Pawnee	46	do	Yellow	32.5960
Platte	48a	do	do	26.1400
Richardson	49	do	do	33.7360
Sarpy	5	do	do	30.8670
Saunders	51	do	do	30.1700
Sherman	67	do	White	37.7540
Washington	19	do	Yellow	32.8314
Do	13a	do	do	34.0010
Webster	52	do	do	33.3990
Missouri:				
Atchison	2	Dent	Yellow	46.4220
Do	3	do	do	45.9750
Barry	4	do	White	50.1380
Barton	5	do	White mixed	35.4430
Bollinger	7	do	White	44.7870
Do	7a	do	Yellow	40.2990
Caldwell	10	do	do	40.3230
Carter	15	do	White	45.6560
Cedar	90	do	Red	40.5160
Christian	16	do	White	44.0020
Dallas	22	do	do	36.1920
De Kalb	94	do	Yellow	47.7470
Dent	24	do	do	38.7070
Dunklin	26	do	Red	39.8890
Gasconade	28	do	White	34.4340
Harrison	31	do	Yellow	50.4940
Henry	96	do	do	43.2170
Hickory	32	do	do	31.5960
Iron	98	do	White	37.8310
Johnson	37	do	do	54.0360
Do	37a	do	Yellow	53.0390
Knox	38	do	Red	40.8630
Laclede	39	do	do	56.5390
Macon	47	do	White	55.9110
Madison	48	do	Yellow	37.2830
Maries	100	do	White	38.3780
Marion	101	do	Yellow	33.2060
Miller	50	do	do	38.5970
Moniteau	51	do	White	37.3670
Monroe	52	do	do	39.6940
Montgomery	103	do	Yellow	45.5300
Morgan	53	do	do	43.1300
New Madrid	54	do	White	26.9860
Nodaway	56	do	Yellow	28.6320
Osage	57	do	do	43.6740
Ozark	58	do	do	57.6890
Pike	61	do	do	33.5950
Platte	62	do	White	46.8910
Do	62a	do	Streaked	40.6350
Pulaski	64	do	Yellow	46.3600
Do	64a	do	White	50.7280
Ralls	66	do	Streaked	58.7740
Ripley	68	do	White mixed	37.1610
Saint Francis	71	do	Yellow	39.5320
Saint Genevieve	72	do	Streaked	27.4880
Saint Louis	73	do	Yellow	38.3670
Do	73a	do	White	38.8740
Schuyler	74	do	Yellow	31.0690
Scott	76	do	White	38.2430
Shelby	77	do	Red	35.1860
Stoddard	78	do	White	42.3290
Stone	79	do	do	36.7240
Taney	80	do	do	52.8770
Vernon	81	do	do	46.2650
Warren	82	do	do	31.5960
Wayne	84	do	do	37.1600
Do	84a	do	do	34.6300
Worth	85	do	do	26.3210
Arkansas:				
Arkansas	1	Dent	Mixed	46.6680
Baxter	2	do	Yellow	41.8600
Bradley	3	do	White mixed	44.3240
Carroll	5	do	White	33.2310

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
				Grams.
Arkansas—Continued.				
Columbia	9	Dent	Mixed	37.0570
Craighead	11	do	White	43.4640
Crawford	12	do	White mixed	36.4120
Crittenden	13	do	do	38.5940
Dallas	15	do	White	37.6780
Dorsey	16	do	do	40.6680
Drew	17	do	do	35.9580
Franklin	18	do	do	41.2990
Fulton	19	do	White mixed	49.9080
Grant	21	do	Yellow	33.8740
Hempstead	22	do	White mixed	39.5840
Do	22*a*	do	Red	43.7830
Howard	23	do	White mixed	35.5280
Independence	24	do	do	43.4040
Izard	25	do	Flesh	39.1470
Jackson	26	do	White	46.4070
Jefferson	27	do	White mixed	35.9630
La Fayette	29	do	White	38.4100
Lincoln	31	do	Yellow	49.8740
Do	31*a*	do	White mixed	43.7840
Marion	35	do	White	47.7520
Mississippi	36	do	do	34.0920
Montgomery	37	do	Flesh	42.5310
Nevada	38	do	White	40.4280
Perry	40	do	do	44.0520
Phillips	41	do	do	34.1700
Do	42	do	do	43.4960
Searcy	49	do	do	46.0190
Sharp	52	do	White mixed	44.1390
Stone	53	do	White	55.5810
Yell	57	do	do	34.9030
Kansas:				
Allen	1	Dent	Yellow	45.9640
Barton	5	do	White	32.5590
Bourbon	6	do	Yellow	40.4200
Brown	7	do	White	35.8580
Chautauqua	9	do	Streaked	43.7080
Cherokee	10	do	White	39.8440
Do	10*a*	do	Yellow	39.4520
Clay	11	do	do	29.4040
Coffey	13	do	White mixed	36.6340
Do	13*a*	do	Yellow	40.4570
Crawford	15	do	White	33.6288
Decatur	17	Flint	Yellow	28.3320
Dickinson	18	Dent	Streaked	42.3760
Do	18*a*	do	Yellow	39.2370
Douglas	19	do	White	39.6220
Ellsworth	23	do	do	50.8150
Ford	25	do	Red	34.1490
Greenwood	28	do	Yellow	35.8090
Harper	29	do	White	37.9610
Harvey	30	do	Yellow	41.4880
Hodgeman	31	do	White	24.2170
Jewell	70	do	Streaked	39.1190
Do	70*a*	do	Yellow	38.8740
Kingman	37	do	White	42.6530
Do	37*a*	do	Yellow	46.5290
Labette	38	do	do	44.5380
Leavenworth	40	do	do	38.7040
Lincoln	41	do	Red	50.0360
Do	41*a*	do	Yellow	39.4130
Linn	42	do	Striped	45.0980
Lyon	43	do	Yellow	55.1700
Marshall	46	do	do	42.3340
Nemaha	50	do	do	31.5770
Neosho	51	do	do	33.8760
Norton	53	do	White mixed	47.7980
Osborne	55	do	Yellow	36.0960
Pawnee	57	do	White	37.5650
Pottawatomie	59	do	Yellow	40.0630
Rawlins	60	do	do	29.5060
Reno	61	do	White	38.3770
Do	61*a*	do	Yellow	39.3440
Republic	62	do	do	48.2930
Shawnee	69	do	do	34.4940
Sumner	73	do	Red	51.1690
Wabaunsee	74	do	Yellow	31.4350
Indian Territory:				
Chickasaw	2	Dent	Red	42.0630
Do	2*a*	do	Yellow	32.8680

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
				Grams.
Indian Territory—Continued.				
Choctaw	3	Dent	White	48.2520
Tahlequa	5	do	White mixed	43.2790
Texas:				
Anderson	1	Dent	White	40.8520
Angelina	2	do	Yellow mixed	30.2600
Arausas	3	do	White	32.4440
Austin	4	do	do	24.0650
Bandera	5	do	do	36.4350
Bowie	10	do	Yellow mixed	48.1970
Brown	13	do	Yellow and red	37.6200
Burleson	14	do	White	44.9240
Callahan	16	do	do	36.6350
Cass	18	do	do	51.4440
Cherokee	20	do	Mixed	40.0240
Collins	23	do	Yellow	35.2530
Colorado	24	do	White	37.6940
Comanche	25	do	Yellow streaked	46.0680
Dentoo	30	do	Yellow	36.8720
Do	30*a*	do	White	45.7720
De Witt	31	do	do	39.0130
Eastland	33	do	Yellow	43.8620
El Paso	35	Flint	Mixed	29.3970
Falls	37	Deot	White mixed	32.6080
Fannin	38	do	Yellow	43.1930
Do	38*a*	do	White	39.8540
Fort Bend	40	do	White mixed	33.3710
Goliad	43	do	Yellow	38.8770
Grayson	45	do	White mixed	43.3590
Gregg	46	do	White	46.2790
Guadalupe	48	do	Mixed	37.0450
Hardemao	49	do	Yellow	36.8040
Harrisoc	51	do	White mixed	36.0880
Huot	55	do	White	57.2310
Jack	56	do	Streaked	40.6730
Jackson	57	do	White	27.8950
Karnes	61	do	Yellow	28.1680
Kaufman	62	do	Mixed	31.9880
Kendall	63	do	White mixed	42.6770
Kerr	64	do	Yellow	29.4230
Kioney	66	do	White	36.8350
Lampasas	67	do	White mixed	35.3770
Lavaca	68	do	do	29.9830
Lee	69	do	White	34.9560
Leon	70	do	White mixed	44.4950
Matagorda	76	do	White	37.8030
Medina	77	do	do	41.1280
Menard	78	do	do	26.6530
Nueces	83	do	Yellow mixed	30.6020
Panola	85	do	White	34.4860
Parker	86	do	Red	42.8480
Polk	87	do	Mixed	36.5840
Rusk	93	do	White	37.9830
San Saba	96	do	do	40.9840
Shelby	98	do	Mixed	22.2990
Somerville	99	do	Yellow	34.1640
Stephens	100	do	White, yel., and red	37.6700
Tarrant	101	do	Yellow	31.4250
Throckmorton	103	do	Striped	37.4260
Titus	104	do	White	43.7220
Tom Green	105	do	Mixed	29.8190
Victoria	112	do	White mixed	32.6740
Waller	114	do	do	38.8550
Washington	115	do	White	41.8480
Webb	116	Dent and Flint	do	41.2140
Williamson	117	Dent	Flesh	40.1180
Wise	118	do	Yellow	41.5630
Colorado:				
Custer	14	Dent	Yellow	29.9280
Douglas	4	do	White	16.8545
Fremont	15	Flint	do	41.1520
Gunnisoo	7	Dent	Yellow	19.4905
Jefferson		do	do	30.8917
Larimer		do	do	28.1615
Las Animas	16	do	Yellow mixed	39.1460
Pueblo	10	do	Yellow and white	33.8632
Utah:				
Box Elder	1	Dent	Yellow	34.4580
Millard	7	Flint	Mixed	27.7030
Morgan	8	do	do	25.7850

CORN, WEIGHT OF 100 KERNELS—CONTINUED.

State and county.	Serial number.	Variety.	Color.	Weight.
				Grams.
Utah—Continued.				
Salt Lake	10	Dent	Yellow	37.5040
Sevier	11	do	do	17.8290
Washington	14	Flint	White	36.2430
Weber	15	do	Yellow	46.9960
New Mexico:				
Colfax	1	Flint	White	35.0450
Doña Aña	2	Dent and Flint	Mixed	33.4360
Grant	3	Dent	White	35.1530
Santa Fé	7	Flint	Black	32.7900
Washington Territory:				
Assotin	6	Dent	White	28.0380
Garfield	7	Flint	Yellow	44.4785
Whatcom	18	do	Reddish yellow	43.8130
Oregon:				
Columbia	5	Dent	Yellow	30.1540
Coos	6	Flint	do	24.9590
Lane	10	Dent	Mixed	36.6620
Linn	11	Flint	Yellow	35.7600
Marion	12	Dent	White mixed	43.3380
Yam Hill	17	do	White	31.7390
Nevada:				
Esmeralda	4	Flint	Yellow	27.1390
California:				
Amador	4	Dent	Yellow	28.1960
Calaveras	13	Flint	do	33.2986
Contra Costa	7	Dent	White	29.9986
Do	18	do	Yellow	42.7586
Mendocino	27	do	White	33.2530
Napa	28	do	Yellow	21.6030
Placer	30	do	do	36.8930
San Benito	3	do	Yellow and white	31.3476
San Bernardino	8	do	White	41.0386
San Diego	15	do	do	49.1130
San Joaquin	9	Flint	do	24.5209
Santa Cruz	5	Dent	Yellow	39.0850
Shasta	11	do	do	28.9954
Stanislaus	12	do	White	41.5910
Tuolumne	16	do	do	31.0046
Yuba	34	do	Yellow	25.4550

The weight of nearly eleven hundred specimens have been taken and the results divided as Dent, Flint, and Flint-Dent.

Averages from the results have been calculated for the whole country, different sections, and each State.

CORN, AVERAGE WEIGHT OF 100 KERNELS.

Dent.

Locality.	No. of samples.	Average.	Highest.	Lowest.
		Grams.	*Grams.*	*Grams.*
United States	1,009	36.7475	64.1020	13.8586
Middle States	34	30.6963	58.1560	27.4900
Southern States	427	40.8233	64.1020	15.5040
Northern Central States	177	33.5430	51.2106	13.8586
Northwestern States	140	29.1013	47.2490	16.0737
Southwestern States	202	39.8208	57.6890	22.2990
Mountain region	10	32.3279	39.1460	16.8545
Pacific States	18	34.7727	49.1130	21.6030
New York	2	31.0393	33.3200	28.7586
Pennsylvania	12	34.9457	41.3569	27.4900
New Jersey	5	44.2956	56.6640	35.7330
Maryland	15	42.7112	58.1560	34.0010
Virginia	54	43.2024	59.7100	24.1600
West Virginia	27	39.2584	50.8610	26.7720
Kentucky	54	42.4498	60.9090	28.0280
Tennessee	60	45.2508	64.1020	29.6330
North Carolina	58	42.6440	60.6360	30.1470
South Carolina	17	37.3088	54.6680	27.1930
Georgia	72	39.6891	63.1250	25.1970
Florida	8	33.6086	44.1160	26.7860
Alabama	36	37.9630	56.6144	21.1625

CORN, AVERAGE WEIGHT OF 100 KERNELS—CONTINUED.

Dent—Continued.

Locality.	No. of samples.	Average.	Highest.	Lowest.
		Grams.	*Grams.*	*Grams.*
Mississippi	29	36.0731	55.2550	22.7770
Louisiana	12	31.9912	39.7050	15.5040
Michigan	10	31.4784	42.6000	20.9080
Wisconsin	1	22.3190	.....	.....
Ohio	52	32.4428	43.8076	21.1618
Indiana	55	34.2614	51.2106	13.8586
Illinois	59	34.3831	46.8000	22.6770
Minnesota	27	24.0159	39.8516	16 0737
Dakota	24	26.1268	37.2568	18.5560
Iowa	47	31.7087	45.3770	22 9360
Nebraska	42	33.5332	47.2490	22.1462
Missouri	58	40.9470	57.6890	26.3210
Arkansas	35	41 3725	55.5810	33 2310
Kansas	44	39 8887	55.1700	24.2170
Indian Territory	4	41.6155	48.2520	32.8680
Texas	61	37.6929	57.2310	22.2990
Colorado	7	28.3336	39.1460	16.8545
Utah	3	29.9303	37.5040	17.8290
New Mexico	1	35.1530	.....	.....
Washington Territory	1	28.0380	.....	.....
Oregon	4	35.4732	43.3380	30.1540
California	13	34.9905	49.1130	21.6030

Flint.

United States	81	32.6254	54.4970	17.6820
New England States	15	32.0839	51.7450	17.7670
Middle States	29	32.9688	54.4970	18.6986
Southern States	5	33.5484	41.6220	25.4800
Northern Central States	6	30.9293	35.6920	26.8200
Northwestern States	10	30.1772	41.2822	17.6820
Southwestern States	2	28.8645	29.3970	28.3320
Mountain region	7	35.0963	46.9960	25.7850
Pacific States	8	33.6780	44.4785	24.5200
Maine	6	30.4801	41.7080	21.3015
New Hampshire	1	17.7670	.....	.....
Vermont	2	28.4020	30.1690	26.6350
Massachusetts	5	39.2321	51.7450	28.7824
Connecticut	1	37.6470	.....	.....
New York	22	30.2896	43.1110	18.6986
Pennsylvania	3	38.4430	43.7330	35.6170
New Jersey	2	41.9360	46.2980	37.5740
Maryland	2	45.2660	54.4970	36.0350
Kentucky	1	39.7160	.....	.....
South Carolina	1	31.5070	.....	.....
Georgia	2	33.5510	41.6220	25.4800
Louisiana	1	29.4170	.....	.....
Michigan	6	30.9293	35.6920	26.8200
Minnesota	7	30.2036	41.2822	17.6820
Dakota	2	31.4166	32.1986	30 6346
Montana	1	26.5140	.....	.....
Kansas	1	28.3320	.....	.....
Texas	1	29.3970	.....	.....
Colorado	1	41.1520	.....	.....
Utah	4	34.1817	46.9960	25.7850
New Mexico	2	33.8975	35.0450	32.7500
Washington Territory	2	44.1457	44.4785	43.8130
Oregon	2	30.3595	35.7600	24.9590
Nevada	1	27.1390	.....	.....
California	3	31.0915	33.2986	24.5209

Dent and flint.

United States	7	34.8330	41.2140	28.0200
Southern States	5	33.8363	40.4520	28.0200
Southwestern States	1	41.2140	.....	.....
Mountain region	1	33.4360	.....	.....
Virginia	2	34.2360	40.4520	28.0200
North Carolina	1	33.2440	.....	.....
Florida	1	31.1340	.....	.....
Alabama	1	36.3313	.....	.....
Texas	1	41.2140	.....	.....
New Mexico	1	33.4360	.....	.....

As regards variety, the Dent, as would be expected, averages heavier per hundred kernels than the Flint, and with it also lie the extremes of weight, sixty-four grams per hundred and thirteen. In southern latitudes the Dent kernels are much heavier than in the northern, between the Middle States and the Southern there being a difference of ten grams per hundred. In New England Dent corn is hardly ever raised, but the Flint which is raised nearly equals in weight the Dent of Pennsylvania. Conversely, Flint is only raised in the North and Northwest, and there excels in weight.

The heaviest corn comes from Virginia, North Carolina, Kentucky, and Tennessee, and from the last-named State the heaviest single specimen. The weight per hundred kernels in the larger corn-producing States averages about thirty-two grams (or an ounce), Missouri being somewhat higher—forty grams.

Further study of the table will readily show those interested other peculiarities which it is unnecessary to comment upon at length.

CONCLUSION.

In ending this report it is merely necessary to call attention to sources of error in work of the kind just described. The chief one is from analyses of samples which misrepresent the locality or substance for which they are taken. It is difficult always to avoid such errors, but it is hoped that no mistakes of this sort have crept into the present bulletin. The methods of analyses were such as have been described in previous reports, and all results in doubtful instances have been confirmed by duplicate.

My assistants have been Mr. Edgar Richards, Mr. A. E. Knorr, Mr. Miles Fuller, and Dr. William Frear, and to them is due the credit for a large portion of the analytical work. The baking experiments have been carefully carried on by Mr. John Dugan, while my personal supervision has extended in all directions.

In another bulletin the results of further investigation of the cereals will be reported upon.

APPENDIX.

ON THE COMPOSITION OF THE ASH OF THE WHEAT GRAIN AND WHEAT STRAW GROWN AT ROTHAMSTED IN DIFFERENT SEASONS AND BY DIFFERENT MANURES BY SIR J. B. LAWES AND J. H. GILBERT.

Under this title Lawes and Gilbert have recently published the results of a study of the constituents of wheat which are derived from the soil and of the conditions modifying their assimilation. It has seemed desirable to present their conclusions here as an appendix to the preceding report, and to remark upon their relations to the American plant. The following is therefore given in their own words:*

SUMMARY AND CONCLUSIONS.

The investigation comprises the analyses of 92 wheat-grain and 92 wheat-straw ashes, and, including 69 duplicates, the number of complete ash analyses involved is 253. Every ash is of produce of known history of growth as to soil, season, and manuring, all the specimens having been grown in the experimental field at Rothamsted, which has now yielded wheat for forty years in succession, 1844 to 1883, inclusive. The results are arranged in three series.

FIRST SERIES OF ANALYSES.

1. This series includes results obtained under three very characteristically different conditions as to manuring in each case for sixteen consecutive seasons. The manuring conditions were: Plot 2, farm-yard manure every year; that is, with an excessive supply both of nitrogen and of mineral or ash constituents. Plot 3, without manure every year; that is, with exhaustion of both nitrogen and ash constituents. Plot 10*a*, with ammonium salts alone every year; that is, with an excess of supplied nitrogen, but with great relative deficiency of ash constituents. The results thus illustrate the influence of fluctuations of season from year to year, under known but very different conditions as to manuring.

2. There was a much greater range of variation in the percentages of potash and phosphoric acid in the ashes both of grain and straw, due to variations of season than to variation of manure. The range of variation due to season was much the greater in the straw ashes, which is explained by the fact that favorable or unfavorable seed forming and ripening may supervene on conditions of high or of low luxuriance,

* Journal of the Chemical Society, Vol. XLV, August, 1884.

that is, of great or of limited activity of accumulation of constituents by the plants; hence the withdrawal of constituents for seed-formation will leave very various amounts of migratory matters in the straw.

3. Taking high weight per bushel of the grain as a fairly good indication of high quality, and *vice versa*, there was with each condition of manuring a general and marked but not uniform tendency to low proportions of nitrogen, of total mineral constituents (ash), and of individual ash constituents, in the dry substance of the grain of the seasons of higher quality; that is, the higher quality of the grain is associated with the greater accumulation of the non-nitrogenous matters (carbohydrates) in proportion to the nitrogen and to the mineral constituents which have been stored up.

4. *Per* 1,000 *dry substance of the grain* there is with each condition as to manuring much greater uniformity in the amount, and a rather lower average amount of potash in the eight better than in the eight worse seasons. Yet it is in a very unfavorable season that there was actually the lowest, and in the worst season of the sixteen that there was actually the highest proportion of potash in the dry substance of the grain; that is, the very different results are obtained under defective but very different conditions of development and maturation.

5. *Per* 1,000 *dry substance of the grain* there is under each of the three conditions as to manuring a lower average amount of phosphoric acid over the eight better seasons, and it is lower in individual seasons of high quality, still there is a wider range than among the eight inferior seasons and wider than in the case of the potash. In the case of the farm-yard manure-plot the lower proportion of phosphoric acid in the better seasons cannot be due to exhaustion, but to enhanced production of organic substance. The average proportion of phosphoric acid to organic substance is, however, lower without manure than with farm-yard manure, and lower still with ammonium salts alone, in which case there is very abnormal mineral exhaustion.

6. The details illustrate in a striking manner the greater influence of season than of manuring on the proportion of the ash constituents to the organic substance of the grain. With normal maturation it is, under otherwise comparable conditions, nearly uniform with different conditions as to manuring; and deviations from normal mineral composition are associated with deviations from normal development of the organic substance.

7. The percentage of silica in the dry substance of the straw is lower in the seasons of more favorable maturation. In fact, stiffness of straw depends on favorable development of the woody substance, by the increase of which the proportion of the accumulated silica to the organic substance is reduced.

8. Excluding the ferric oxide and the silica, and calculating the whole of the phosphoric acid, as tribasic, the grain ashes show more than one and a half times as much acid as base; and even calculating

the whole of the phosphoric acid, whether combined with alkalis or earths as bibasic, there is still an excess of acid. The straw ashes, calculated in the same way, show a considerable excess of base, even reckoning the whole of the phosphoric acid as tribasic; but they contain more than 60 per cent. of silica. The question arises whether carbonic acid (if any) and some sulphuric acid and chlorine have not been expelled in the incineration in the case of the grain-ashes in the presence of acid-phosphates, and in that of the straw ashes in the presence of an excess of silica.

9. Investigations at Rothamsted and elsewhere have established that there is a general increase in the percentage of nitrogen proceeding from the finer to the coarser flours obtained from the same wheat-grain, and that there is marked increase in the more branny portions, the greatest concentration being immediately below the pericarp. The percentage of potash, lime, magnesia, and phosphoric acid also increases from the finer to the coarser flours, and it is the highest in the branny products. The percentage of potash is about ten times, of lime four or five times, of magnesia fifteen to twenty times, and of phosphoric acid more than ten times as high in the dry substance of the bran as in that of the finer flour. It is also established that, in comparable cases, the better matured grains contain the lower percentages of nitrogen and total mineral matter, and a higher percentage of starch; and the ash analyses now under consideration consistently show a lower proportion of the chief individual mineral constituents in the grains of better quality.

10. The average annual amounts of total mineral constituents in the crops *per acre* (grain and straw) over the sixteen years were—with farm-yard manure 237.4 pounds, without manure 106.1 pounds, and with ammonium-salts alone 142 pounds; that is, with ammonium-salts one and a third times, and with farm-yard manure more than twice as much as without manure. With ammonium-salts the greatest proportional increase was in lime, potash, magnesia, soda, sulphuric acid, and chlorine, and the least in phosphoric acid. With farm-yard manure, by far the greatest increase was in potash, of which there is more than two and a half times as much as without manure; and there is about twice as much magnesia, and more than twice as much lime, phosphoric acid, sulphuric acid, soda, and silica, and nearly four times as much chlorine.

11. Comparing the amounts of the individual ash constituents *in the crops per acre* over the first eight years with those over the second eight, they are, without manure, in the grain nearly identical, but in the straw there is more or less deficiency of every constituent, excepting lime, over the second period. Deficiency in the straw and total produce, generally but not uniformly, indicates deficient source. With farm-yard manure there was more of every ash-constituent (excepting sulphuric acid) in the grain, straw, and total produce, over the second period; the most marked increase being, in the grain in potash and phosphoric acid, and

in the straw in potash and silica. With ammonium-salts alone there was, over the second period, in the grain slight deficiency of potash and magnesia, and greater in phosphoric acid, but there was slight increase in lime and sulphuric acid. In the straw there was more marked deficiency in every constituent, excepting sulphuric acid, and the deficiency is the most marked in potash, phosphoric acid, chlorine and silica, though chlorine is largely supplied in the ammonium-salts.

12. Upon the whole, the comparison of the yield of ash constituents *per acre* over the first and second eight years shows, without manure a small relative exhaustion of both potash and phosphoric acid, and with ammonium-salts a greater relative exhaustion of both.

13. *Per* 1,000 *dry substance of grain* there were taken the average of the sixteen years, almost identical amounts of each of the ash-constituents without manure, and with farm-yard manure; but with ammonium-salts alone there was marked deficiency, especially of phosphoric acid, and in a less degree of potash. *Per* 1,000 *dry substances of straw*, there was, without manure considerably less potash than with farm-yard manure, but otherwise not much difference. With ammonium-salts alone there was still greater deficiency of potash, but more lime, less phosphoric acid, but more sulphuric acid, and considerably less silica, than either without manure or with farm-yard manure.

14. Comparing the amounts of ash constituents per 1,000 *dry substance of the grain, over the first* and *second eight years*, with farm-yard manure they are almost identical over the two periods, and without manure very nearly so, but there is slightly less potash, and more magnesia and phosphoric acid, over the second period—conditions indicating less perfect maturation, that is, less flour in proportion to bran. With ammonium-salts alone the dry substance of the grain shows a marked deficiency of potash and magnesia, and especially of phosphoric acid compared with that of the other plots; it nevertheless shows very little difference comparing the second eight years with the first, though there is a slight decrease of phosphoric acid and increase of sulphuric acid and silica over the second period.

15. *Per* 1,000 *dry substance* of the straw, the amount of the various ash-constituents varies more over the two periods than in the case of the grain, but still comparatively little. Without manure there is over the second period a deficiency of potash and magnesia, partially compensated by lime, also a deficiency of phosphoric acid. With ammonium-salts, the most marked deficiency over the second period is of potash; there is also less chlorine, but more sulphuric acid.

16. In conclusion in regard to this first series of ash analyses, although the results show a much wider range of variation in the mineral composition of the grain due to season than to manuring, there are still distinct differences due to the very different conditions as to manuring; but with each of the three conditions there is comparatively little difference over the first and the second eight years. With ammonium-salts

alone, where there is very abnormal mineral exhaustion, the dry substance of the grain shows relative deficiency of both potash and phosphoric acid, but especially the latter. Upon the whole the results point to great uniformity in the mineral composition of the grain under the different conditions of manuring, provided only that it is perfectly and normally ripened. High or low percentage of nitrogen is also more dependent on the conditions of maturation than on full or limited supply of it by the soil.

SECOND SERIES OF ANALYSES.

1. This series relates to the produce obtained under nine different conditions as to manuring, each in two unfavorable, and in two favorable seasons for the crop. They thus illustrate the influence of characteristic seasons under a great variety of manuring conditions.

2. The manuring conditions were: Farm-yard manure; without manure; superphosphate, and sodium, potassium, and magnesium sulphates; ammonium-salts alone; ammonium-salts and superphosphate; ammonium-salts, superphosphate, and sodium sulphate; ammonium-salts, superphosphate, and potassium sulphate; ammonium-salts, superphosphate, and magnesium sulphate; ammonium-salts, superphosphate, and sodium, potassium, and magnesium sulphates.

3. The four seasons were: 1852 and 1856, which were unfavorable, and 1858 and 1863, which were favorable for the crop; 1852 (the ninth from the commencement of the experiments) was bad both as to quantity and quality of produce; 1856 gave fairly average quantity both of grain and straw, but the crop was unevenly ripened, and the quality of the grain was low; 1858 yielded only a moderate amount of total produce, but more than average proportion and amount of grain, which was of over average quality; 1863 (the twentieth year of the experiments) was the best both as to quantity and quality of produce throughout the forty years, 1844–1883, inclusive.

4. Taking the mean results of the nine plots in each of the four seasons, there was from the first to the fourth season an increase in the weight per bushel of the grain, and in the proportion of grain to straw, and a decrease in the percentages of nitrogen and total mineral matter in the dry substance of the grain. Coincidently with these characters, there was, from the first to the fourth season, great increase in the percentage of potash, and considerable decrease in that of magnesia, and there was great decrease in the percentage of phosphoric acid, and an increase in that of sulphuric acid, *in the grain-ash*.

5. *Calculated per* 1,000 *dry substance of the grain*, there was more potash and less magnesia, and especially much less phosphoric acid, and some more sulphuric acid in the produce of the two later and better seasons. These are indications of higher proportion of flour to bran, that is, of more starch. The variation in the mineral composition is thus associated with variation in the organic composition of the grain.

Per 1,000 *dry substance of the straw*, there was also more potash, less phosphoric acid, and more sulphuric acid in the better seasons.

6. *Calculated per acre*, there was about twice as much grain, nearly one and a half times as much straw, and more than one and a half times as much total produce in the best as in the worst of the four seasons. Of total nitrogen *in the crop per acre*, there was an average of only 38 pounds in 1852, and of 50.1 pounds in 1863; while of the less total quantity in 1852 a considerably larger actual amount remained in the straw. In 1852, 61.6 per cent.; in 1856, 72.9 per cent.; in 1858, 73.8 per cent., and in 1863, 77.4 per cent. of the total nitrogen of the crops was stored up in the grain. In 1863, with the largest actual amount of nitrogen in the grain *per acre*, there was the lowest *percentage of it in the grain;* that is, under the influence of the very favorable growing and maturing conditions, there was a greater accumulation of non-nitrogenous constituents in proportion to the amount of nitrogen stored up.

7. *Calculated per acre*, there was in 1863 one and a third times as much total mineral matter in the crop as in either of the other years. Comparing the best and the worst seasons (1863 and 1852), there was one and a half times as much lime, magnesia, and phosphoric acid, and about twice as much potash and sulphuric acid in the total produce *per acre* in the season of most favorable growth and maturation. Yet, *per* 1,000 *dry substance of the grain*, the amounts of lime, magnesia, and phosphoric acid were lower, and the amount of potash was not much higher in the better seasons.

8. Taking the average results over the four years, for each of the nine different conditions as to manuring separately, there is, with one or two exceptions, comparatively little variation in weight per bushel with the equal season, but very varying manuring conditions; and the differences, such as they are, are consistent. The percentage of nitrogen is also in the main fairly uniform with the different manures; but it is low with mineral manure alone and great nitrogen exhaustion, and high with ammonium-salts alone and relatively excessive nitrogen supply. The percentages of total mineral matter are also fairly uniform, but somewhat higher with farm-yard manure, without manure, and with mineral manure alone, and low with ammonium-salts alone.

9. *Per* 1,000 *dry substance of the grain* there is also general uniformity in the amount of the chief individual ash constituents under the very different manuring conditions. The exceptions to uniformity in the amounts of potash are, that it is somewhat high without manure and with purely mineral manure, and somewhat low with ammonium-salts alone, and with ammonium-salts and superphosphate, but without potash. The exceptions to general uniformity in the amounts of phosphoric acid are, that it is high with farm-yard manure, without manure, and with purely mineral manure, and low with ammonium-salts alone.

10. *Per* 1,000 *dry substance of the straw* the amounts of the individual ash constituents are much more variable on the different plots. The

variation is especially marked in the case of the potash and phosphoric acid, and it is obviously much dependent on their supply. It is also very marked in the case of the silica.

11. *Calculated per acre*, there is very great variation in the amounts of produce, and of its various constituents, according to manure. Without manure and with purely mineral manure, the produce was very small; it was much more with ammonium-salts alone, and much more still with ammonium-salts and mineral manure together. With ammonium-salts and the most complete mineral manure, there was more than one and a half times as much produce as with ammonium-salts alone, and nearly two and and a half times as much as with mineral manure alone. There were in the main corresponding differences in the amounts of nitrogen, total mineral matter, and the chief individual ash constituent, stored up in the crops.

12. Of potash, the ashes show three times as much in the total produce *per acre* with farm-yard manure and more than three times as much in that with ammonium-salts and mineral manure containing potash, as without manure. On the other plots (excepting with mineral manure alone), the quantities of potash in the crops are obviously dependent on the supply. Of the total potash of the crops, there is generally only from one-fourth to one-third accumulated in the grain.

13. Of phosphoric acid there was little more than twice as much *per acre* in the highly manured as in the unmanured produce; but three-fourths or more of the total phosphoric acid of the crops may be accumulated in the grain.

14. Of the total lime and sulphuric acid of the crop a very small proportion; of the magnesia, generally more than half; of the chlorine, scarcely a trace, and of the silica, the smallest proportion of all, is found in the grain-ashes.

15. With very great variation in the amounts of nitrogen and ash constituents *in the total crop per acre* on the different plots, there is remarkable uniformity in the amounts of each *per* 1,000 *dry substance* of *grain*; but wide variation in the amounts *per* 1,000 *dry substance* of *straw*. The greatest exceptions to uniformity in the amount of potash per 1,000 dry substance of the grain are that it is low with ammonium-salts alone, or with superphosphate only in addition (10*a* and 11*a*), and high without manure, and with purely mineral manure, (3 and 5*a*). The most marked deviations from general uniformity in the amount of phosphoric acid in the dry substance of the grain are, that it is low with ammonium-salts alone (10*a*), and high with farm-yard manure, without manure, and with purely mineral manure (2, 3, and 5*a*).

16. With every condition of manuring there is, *in the grain ashes*, a higher percentage of potash, and a lower of phosphoric acid, and somewhat lower of magnesia also, in the two favorable seasons, indicating higher proportion of flour to bran. There is lower percentage of phosphoric acid in the better seasons, even where there is liberal supply of

it, but the lowest is on plot 10*a*, where it is the most exhausted. The *straw ashes* also show a higher percentage of potash in the two better seasons.

17. With decline in the percentage of phosphoric acid in the ashes there is increase in sulphuric acid, and in the straw ashes increase of chlorine in a greater degree. It is a question how far the small amounts of sulphuric acid and chlorine in the grain ashes are due to the presence of so much acid phosphate, and how far the much larger amounts in the straw ashes are due to their excess of base to acid other than silica, although of this there is so much.

18. *Calculated per* 1,000 *dry substance* of *the grain*, there is, with every condition as to manuring, a higher amount of potash in 1858, and almost without exception in 1863, than in the two unfavorable seasons. On the other hand, the proportion of phosphoric acid is in 1858 almost without exception, and in 1863 without exception, lower than in the unfavorable seasons.

19. The second series of analyses, as did the first, consistently show considerable variation in the mineral composition of wheat grain, according to season, but little according to manuring (excepting in cases of abnormal exhaustion), provided the seed be properly matured. In fact, variations in the mineral composition are associated with differences in the organic composition.

THIRD SERIES OF ANALYSES.

1. This series was more especially arranged to trace the influence of supply or exhaustion. The ashes represent the produce obtained under ten different conditions as to manuring, each over ten years, 1852–1861, and ten years, 1862–1871. Nine of the plots are substantially duplicates of those to which series two relates; and the tenth, 10*b*, is a duplicate of 10*a*, with ammonium-salts alone, excepting that twice prior to the period now under consideration it received mineral manure, including potash and phosphoric acid, when 10*a* did not.

2. The average results *per acre*, of the ten plots, for each of the two periods, show that the first ten years were on the average the more favorable for luxuriance, that is, for total accumulation by the plant, and the second ten the more favorable for seed formation and maturation. Accordingly, with less mineral matter in the total produce per acre over the second ten years, there was as much or more of almost every individual ash constituent accumulated in the grain.

3. With each condition of manuring where the nitrogen supply was not deficient, there was more grain, and of better quality, over the second ten years. Comparing plot with plot, there was over both periods, with equal nitrogen supply, considerable increase by the addition of superphosphate and potash. Comparing the second period with the first, the influence of supply or exhaustion, especially of potash, is very marked (10*a*, 10*b*, 11*b*, 12*b*, 14*b*, 13*b*, and 7*b*).

4. With equal supply of nitrogen very variable amounts of it are found in the total produce per acre of the different plots according to the associated mineral supply.

5. Of individual ash constituents there was more in the *total produce per acre* with some of the artificial manures than with farm-yard manure. Comparing the plots with equal ammonium-salts, but different potash supply, the amounts of potash in the total produce are in the order of the supply.

6. Comparing plots 12*b*, 13*b*, 14*b*, and 7*b*, all with the same nitrogen supply, but the first and third with a decreasing residue of potash from previous applications, and the second and fourth with an annual supply of it, the amounts of potash in the *total produce per acre per annum* over the first ten years are, 45.4, 53.2, 49.8, and 56.0, but the amounts in the grain are 11.4, 11.3, 11.3, and 11.9; over the second period, with the further exhaustion on the first and third plots (12*b* and 14*b*), the amounts of potash in the total produce are 37.8, 55.2, 39.1, and 53.0, but the amounts accumulated in the grain are 11.4, 12.2, 11.6, and 12.3. Thus the amounts in the total produce are directly influenced by the supply or exhaustion, especially over the second period; but over each period the amounts in the grain are nearly identical on the four plots, showing only slight relative deficiency over the second period on plots 12*b* and 14*b*, with their reducing residue of potash supply.

7. The amount of phosphoric acid in the *total produce per acre* varies much with equal supply of it and of nitrogen, and is obviously much dependent on the available supply of potash. The amounts of mineral constituents accumulated in the total plant (as indicated by the amounts in the total crop) are very directly influenced by the supply or exhaustion; but, other things being equal, the final distribution in the grain is influenced much more by the seed-forming characters of the season than by the amounts of the constituents in the total plant, provided there be not a deficiency.

8. *Percentage composition of the ashes.*—As in the case of the mean results from the ten plots, so in that of each plot (excepting plot 3, without manure), there is a higher percentage of potash in the grain ashes of the second period with its better seed-forming and maturing tendencies. The percentage of potash in the grain ashes only varies from 31.7 to 34.0 over the first, and from 32.1 to 34.1 over the second period; but in the straw ashes it varies from 14.8 to 24.1 over the first, and from 14.1 to 25.0 over the second period. The variations in the straw ashes are consistent with the variations in the supply.

9. Comparing plots 12*b*, 13*b*, 14*b*, and 7*b*, the percentages of potash in the grain ashes are over the first period 32.8, 32.9, 32.6, and 32.9, and over the second period 33.3, 33.5, 33.1, and 33.4; but in the straw ashes they are over the first period 20.1, 24.1, 22.0, and 23.7, and over the second period, with the increasing exhaustion on the first and third plots, 12*b* and 14*b*, 17.2, 25.0, 18.5, 24.6.

10. With higher percentages of potash in the grain ashes over the second period, there are also higher percentages of lime, and there is a tendency to higher percentages of magnesia; but there is in every case, excepting without manure, a lower percentage of phosphoric acid, and with this, in every case but one, a higher percentage of sulphuric acid over the second period.

11. *Per* 1,000 *dry substance of the grain* there is generally a lower amount of each ash constituent (excepting lime and sulphuric acid) over the later and better seed-forming and maturing period; there is also a lower amount of nitrogen, and, therefore, a higher proportion of non-nitrogenous constituents. Comparing plot with plot, the amounts of potash *per* 1,000 *dry substance of the grain* are fairly uniform, but even in the grain, and in the straw in a much more marked degree, it is lowest where it is the most exhausted. Comparing plots 12*b*, 13*b*, 14*b*, and 7*b*, the amounts *per* 1,000 *dry* substance of *the grain* are over the first period 6.46, 6.43, 6.41, and 6.53, and over the second period 6.14, 6.22, 6.16, and 6.33; but in the straw they are over the first period 10.54, 12.90, 11.65, and 12.84, and over the second period, with the increasing exhaustion on the first and third plots, 9.14, 13.29, 9.55, and 12.58.

12. The amounts of phosphoric acid *per* 1,000 *dry substance* of *the grain* varied more according to supply than did that of the potash; but it was, with every condition of manuring, lower over the second and more favorable period. Over the first period it ranged from 8.70 to 10.87, and over the second period from 7.89 to 10.35. On Plots 12*b*, 13*b*, 14*b*, and 7*b* it was, over the first period, 10.05, 10.05, 10.15, and 10.12, and over the second period 9.21, 9.31, 9.38, and 9.49, or much lower over the second period, but within each period almost uniform on the four plots. Taking the whole series of plots, it was the lowest on 10*a* and 10*b*, where it was most exhausted; but it was also low on 11*b*, where it was annually supplied, though without potash, and with defective development accordingly.

13. The results of the third series of analyses agree with those of the first and second in showing, upon the whole, marked uniformity in the mineral composition of the ripened grain, even when there is wide variation in that of the straw dependent on supply or exhaustion. They also show distinct influence of season, and that the differences in the mineral composition of the grain due to season are associated with differences in the organic composition. With less variation in the conditions of season, and of influence therefrom, but with a wider range of mineral supply or exhaustion than in the other series, there is a wider range in the mineral composition of the grain, according to supply or exhaustion; it is, however, comparatively little influenced by excess of supply, but more by deficiency. The three series show that, under otherwise comparable conditions, there is, in the better matured grain, that is, in the grain of higher quality, a lower percentage of total mineral matter (ash); *in the ash*, a higher percentage of potash, but lower

of phosphoric acid; but *in the dry substance* of *the grain* generally a lower percentage of potash, and considerably lower of phosphoric acid, and also a lower percentage of nitrogen

They also add: In conclusion, extensive and comprehensive as has been the inquiry within its own limits, it must be borne in mind that the results relate to the produce obtained on one description of soil, and in one locality only.* Still, the number of very widely different seasons over which the experiments have extended, and the very widely different conditions as to manuring of the different plots, have probably provided a much greater range of conditions of growth than would have been secured had the experiments been made in fewer seasons, on various soils, and in various localities, but with more normal conditions as to manuring. Indeed, the conditions of relative excess, or exhaustion, of the available supply of individual constituents represented in the experiments, the results of which have been recorded, are probably much more distinctive and characteristic than could be obtained under more normal conditions. On this view it is obvious that, while the results are of a very marked character, and are therefore very instructive if properly interpreted, it must not be without careful reservation that their application to the circumstances of actual agricultural practice should be inferred.

THE CONCLUSION OF LAWES AND GILBERT AS VIEWED IN CONNECTION WITH THE RESULTS OF AMERICAN WORK.

Considering the conclusions of these authors by paragraphs as they are numbered, it is found in the first series of analyses and third paragraph that, "taking high weight per bushel of grain as a fairly good indication of high quality, and *vice versa*, there was, with each condition of manuring a general and marked but not uniform tendency to lower proportions of nitrogen, of total mineral constituents (ash), and of individual ash constituents, in the dry substance of the grain of the seasons of higher quality. That is, the higher quality of the grain is associated with the greater accumulation of the non-nitrogenous matters (carbohydrates) in proportion to the nitrogen, and to the mineral constituents which have been stored up." And again, in the body of the report the authors remark: "In a very comprehensive investigation of the composition of American wheats, conducted by Mr. Clifford Richardson under the auspices of the Department of Agriculture, at Washington, he finds a generally low average percentage of albuminoids in American as compared with European wheats; and he concludes that this is an indication of inferiority of quality in many cases due to deficient

* It is true that once within the period to which the results relate there was a change of seed from one description to another not very widely different; but there is no evidence leading to the conclusion that this irregularity has at all vitiated the comparative character of the results, or the legitimacy of the conclusions that have been drawn from them.

supply of nitrogen by the soil. It is more probably due to enhanced formation of starch under the influence of high ripening temperature."

Allowing the correctness of their conclusions in their application to the cases which they have had under consideration and to many local instances in the United States where to similar causes have been very evidently due high or low percentages of nitrogen, they are not, however, justified in attributing the poverty of American wheat in nitrogen as a whole to an enhanced starch formation, and for the following reasons:

An enhanced formation of starch, there being no poverty of nitrogen in the soil, increases the weight of the grain and diminishes the relative percentage of nitrogen. Were this the cause of the relatively low percentage of nitrogen in our American wheats, the grain from the Eastern States, which are poorest in this respect, would be heavier than those from the Middle West, which are richer in albuminoids; but this is not the case. Again, formation of starch is attributed by Messrs. Lawes and Gilbert to the higher ripening temperature in America, but we have found that there is scarcely any difference in composition or weight between wheats from Canada and Alabama and if anything those from Canada contain more starch than those from the South, and the spring wheats from Manitoba with its colder climate more than those from Dakota and Minnesota with its milder temperature. In Oregon there is a striking example of the formation of starch and increase in the size of the grain at the relative expense of the nitrogen due to climate but not to high ripening temperature. The average weight per hundred grains of wheat from this State has been found to be 5.044 grams and the relative percentage of nitrogen 1.37, equivalent to 8.60 of albuminoids. These are the extremes for America and are due, as has been said, to the enhanced formation of starch. This, however, is not owing to high ripening temperature, because most of the specimens were grown west of the Cascade Range, which has an extremely moist climate and a summer temperature not exceeding 82° F. for any daily mean. The climate in another way, however, is of course the cause, by producing luxuriant growth, as illustrated by all the vegetation of the country. Numerous other analyses are illustrations of the important effect of surroundings and season upon the storing of starch and consequent relative changes in the composition of the grain. The crop of Ohio for 1883, for instance, as has been remarked in the previous pages of this report, was shriveled in appearance, owing to wet weather about the time of ripening. The result was that the grain was small in size and of light weight, as it could not store up its usual quantity of starch, and the relative percentage of nitrogen was therefore increased. In Dakota the contrast between a winter and a spring wheat has been shown and the cause determined as lack of starch, and consequently size, in the latter variety, and this holds true as a characteristic of all the spring wheats of the Northwest. They are high in nitrogen, small

in size, and contain a greater proportion of bran to flour than winter wheats.

Another peculiarity, dependent in a like manner on climate or season, appeared last year in Colorado, where storms at the time when the grain is usually collecting its nitrogen interfered with the storage of that element, while a revival of vitality later permitted the usual amount of starch to be elaborated, thus decreasing the relative proportion of albuminoids. As a whole, however, the poverty of American wheat in nitrogen, decreasing toward the less exhausted lands of the West, seem to be due more to influences of soil than of climate, while locally the conclusions in paragraph six of the first series of experiments, that the influence of season is greater than that of manure, are confirmed by the crops of 1883 in Ohio and Colorado.

As far as our experiments have gone in the direction of milling the conclusions of paragraph nine are confirmed in every respect, especially as to the greatest concentration of nitrogen being immediately below the pericarp (epicarp of our description). From the analyses of the ash of different parts of the grain they learn, as can be seen in our analyses of roller-milling products, that a large percentage of ash constituents, other things being equal, is indicative of large proportion of bran.

Comparing the crops on an unmanured plot for sixteen years their results seem to show that while the proportion of grain to straw gained during the second half of the period and the weight per bushel changed but little, the relative percentages of nitrogen in the dry matter of the grain and straw decreased noticeably, and this was the case, too, upon the plot manured with ammonium salts alone, showing an intimate connection between the mineral constituents of the grain and the nitrogen. If we may be allowed to consider the grain which has been analyzed from the Western States as corresponding to the first period of eight years of Messrs. Lawes and Gilbert's experiments, and that from the Eastern States as corresponding to the second, then there is a thorough agreement between the two series, the Eastern representing the more worn out and the Western the less exhausted soil, and the conclusions for the English experiments hold good for our wheats. That is to say, the soils of the Eastern States, upon which wheat (or other crops) have been grown for many years without sufficient manure, do not produce for that reason a grain as rich in ash and nitrogen as the fresher soils of the West. When it is possible to carry out extensive experiments in this country under as complete control as those at Rothamsted it will be possible to show this fact in a more particular way.

The second series of experiments brings out the effect of season more strongly than the first but with the same result as has been already discussed. It shows, too, a fact that we have no data for, namely, that

in bad seasons with poor or scanty nourishment the straw suffers more in relative composition than the grain.

From the third series we learn that with numerous conditions of manuring there was more grain and of better quality over the second ten years, and that the amount of nitrogen found in the produce with equal supply was dependent on the associated mineral supply. This seems to show that the application of mineral manures to our Eastern lands should bring up the yield of grain and the quality, as far as we are able to judge and profit by these experiments abroad. Work of a similar character at home would certainly open a vast field of information and be of great benefit to the American farmer who is desirous of cultivating his ground on rational principles, but he will be able to gather from these English experiments much which will be to his advantage if they only serve to show the great susceptibility of wheat to its surroundings.

In another place it is intended to take up the relations of corn (maize) to climate, soil, and season in the same manure as has been done with wheat. It can only be said here that our results have shown that it is the quantity per acre and not the quality of corn which is affected most by conditions of environment.

ERRATA TO BULLETIN NO. 1.

Page 4. No. 722, Blount's Hybrid "No. 16," read "No. 17."
No. 723, Blount's Hybrid "No. 17." read "No. 18."
No. 725, Blount's Hybrid "No. 20," read "No. 21."
Page 5. No. 725, Hybrid "No. 20," read "No. 21."
Page 31. For nitrogen in Alabama wheat read "1.82" instead of "1.79."
Page 37. No. 725, in table, Blount's Hybrid "No. 20," read "No. 21."
Page 41. In last table on the page read for weight of 100 grains in 1882 "4.233" instead of "4.682."
Page 43. "In Virginia a stinted wheat," read "a stunted wheat."
Page 63. Under Colorado for "Blount's Prolific, Flint," read "White Dent."
Page 68. For weight of 100 kernels Field corn, read "36.910" instead of ".910."
Page 69. Twelve lines from foot of page, read "and corn 3.17 per cent." instead of "2.8."

DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY.
BULLETIN No. 9.

THIRD REPORT

ON THE

CHEMICAL COMPOSITION AND PHYSICAL PROPERTIES

OF

AMERICAN CEREALS,

WHEAT, OATS, BARLEY, AND RYE.

BY

CLIFFORD RICHARDSON.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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U. S. DIVISION OF CHEMISTRY.

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13734—No. 9

LETTERS OF TRANSMITTAL.

I.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY,
Washington, D. C., April 2, 1886.

SIR: I have the honor to submit herewith for your approval the final results of the investigations of American cereals which have been made by this Division under the direction of Mr. Clifford Richardson.

These investigations, it is believed, are the most extensive and thorough of any similar ones heretofore carried on, and have revealed the influence of soil and climate on the composition of our grain in a manner which will prove beneficial both to our farmers and manufacturers.

Respectfully,

H. W. WILEY,
Chemist.

Hon. N. J. COLMAN,
Commissioner.

II.

MARCH 31, 1886.

SIR: I have the honor to hand you for transmission to the Commissioner of Agriculture my third report upon American cereals.

Very respectfully,

CLIFFORD RICHARDSON,
Assistant Chemist.

Dr. H. W. WILEY,
Chemist.

COMPOSITION AND PROPERTIES OF AMERICAN CEREALS.

WHEAT.

In previous reports, Bulletins 1 and 4 of the Chemical Division, we have discussed the changes in composition of many varieties of wheat as they have been grown in Colorado during a period of years by Prof. A. E. Blount. His attempts have been to improve by selection and crossing the character of this grain both for the farmer and miller. What success he has met with in increasing the yield and physical characteristics will be evident from the data which follow. It has been our province to study the changes in the chemical composition of the grain from year to year, showing the result of varying conditions in this direction. This has been done for four years, and before giving the results of the last year's examination a summary of those of previous years will serve to make them more intelligible.

The first specimens of wheat were handed to the Division by Professor Blount in 1881, and were of varieties which had been grown two and three years in Colorado. They numbered thirty-three, and had the following average composition:

Weight of 100 grains.	Grams 4.865.
Water ..... per cent..	9.86
Ash ..... do ...	2.28
Oil ..... do....	2.41
Carbohydrates ..... do...	70.48
Crude fiber ..... do....	1.57
Albuminoids ..... do....	13.40
Total	100.00
Nitrogen ..... do....	2.14

From this average it was learned that in that year Colorado produced a grain very rich in albuminoids, large in size, dry, and with little fiber or hull.

Among the specimens it was found that some were from domestic and others from foreign seed, part being Russian. Knowing that Russian wheat is the richest in albuminoids of any in the world, and that continental varieties as a rule contain more than our own, it was of interest to

observe that the crops grown in Colorado were still characterized by the source of the seed.

Average composition of crops from seed from various sources.

	Domestic seed.	Foreign seed.	Russian seed.
Weight of 100 grains ..... grams..	4.714	5.187	5.075
Water ..... per cent..	9.85	9.86	9.69
Ash ..... do ...	2.27	2.32	2.41
Oil ..... do	2.38	2.45	2.44
Carbhydrates ..... do	70.87	69.46	69.33
Crude fiber ..... do	1.58	1.57	1.59
Albuminoids ..... do	13.05	14.34	14.54
Total	100.00	100.00	100.00
Nitrogeu ..... per cent..	2.09	2.29	2.32

These wheats were the richest in albuminoids of any that had been examined up to that time in this country. Since then the hard spring wheats of the Northwest have been found to be more nitrogenous, but not comparable in their size or yield.

The second year, twelve varieties, grown from seed supplied by the Department of Agriculture, were analyzed. After one year, that is to say, the first year's growth in Colorado, they were found to have all increased in size, and instead of an average weight of 3.402 grams per hundred grains, they weighed 4.299 grams. As regards the percentage of albuminoids, where the seed wheat was low in nitrogen there was a gain, but as half of the varieties contained originally more albuminoids than the average Colorado grain, there was a drop in six of the twelve specimens toward the average. For example, a seed having 16.11 per cent. of albuminoids, the crop fell to 14 91 per cent., while one having only 9.65 rose to 12.15 per cent. From these facts, and the analyses of the previous year, the conclusion was drawn that the conditions in Colorado were suited to the production of a grain containing about 13 per cent. of albuminoids.

This was undoubtedly the case at the time. In the two following years, however, these conditions have been somewhat modified.

In the third year, 57 varieties were examined, 28 of which had been analyzed before in 1881. A loss of albuminoids occurred in all but 4 cases, and a loss of weight in all. The average for the year was—

Weight of 100 grains.	Grams 3.941.
Water ..... per cent..	9.38
Ash ..... do ...	2.09
Oil, carbhydrates, and crude fiber... do ...	76.79
Albuminoids ..... do	11.74
Total	100.00
Nitrogen ..... per cent..	1.88

This sudden change and drop in size and percentage of albuminoids were attributed by Professor Blount to a heavy hail-storm, which prostrated the crop in its formation stage and influenced all its characteristics. This was probably the case, and it became of great interest to study the crop of 1884, to learn what the recovery might be, and what, after from one to six years' growth in Colorado, the changes in average composition might amount to.

To this end 77 varieties, selected from a lot of 200 grown by Professor Blount, have been examined chemically and physically, and the results are presented in the following tables, together with certain data in regard to yield per acre, as well as characteristics of the seasons and other conditions, taken from Professor Blount's report and personal letters.

Names, sources of seed, yield, &c., of Colorado wheats.

No.	Name of wheat.	Seed received from—	Color.		Bearded or smooth.	Yield per square rod, pounds.						Bushels per acre, 1884.
			Grain.	Chaff.		1879.	1880.	1881.	1882.	1883.	1884.	
1	Minnesota Fife	Minnesota	White	White	Smooth	6	7	10	19	7½	16⅔	44
2	White Fife	do	do	do	do	7	7	11	15½	8	15	40
3	Sherman	Pennsylvania	Amber	Red	Bearded	6	7⅓	9	18	8	17	45⅓
4	White Russian	Moscow	do	White	Smooth	5	8	14	14½	7	21	56
5	Odessa	Black Sea	Red	Red	do	6	7½	14	13	8	18	48
6	Eldorado	California	White	White	Bearded	4½	5	16	17	9	20	53⅓
7	Soft Australian	Australia	do	do	Smooth	4⅔	9⅓	17	14½	11	20	53⅓
8	Defiance	Vermont	do	do	do	5⅔	8⅓	15	17½	7	22	58⅔
9	Champlain	do	do	do	Bearded	5⅔	7	11	18	8	22	58⅔
10	Oregon Club	Oregon	do	do	Smooth	6½	7	15	17⅔	11	19	50⅔
11	Australian Hard	Australia	do	do	do	8⅔	8½	16	16	8	19½	52
12	Sonora	Mexico	do	Red	do	5	6½	14	16½	5	21	56
13	White Mexican	Siberia	do	White	do	6¼	8½	13	14½	5	15½	41⅛
14	Improved Fife	Minnesota	do	do	do	5	5⅓	13	17	8	21	56
15	Russian	Russia	Amber	do	do	5	5½	14	19	8	19½	52
16	Brooks	Pennsylvania	White	do	do	4½	5⅓	16	15	7	19	50⅔
17	Rio Grande	Mexico	Red	do	Bearded	5	10	11	17	12	21	56
18	Canada Club	Canada	White	do	Smooth	5⅓	6	11	19	6	19	50⅔
19	Judkin	Pennsylvania	do	do	do	6½	5	10	18	6	20	53⅓
20	Lost Nation	Illinois	Red	do	do	5½	4½	11	17	6	15⅔	41⅓
21	Tonzelle	France	White	do	Bearded	6	5	15	18	4	17	45⅓
22	Australian Club	Australia	do	do	Smooth	7	6	13	19½	6	19	50⅔
23	Golden Globe	Pennsylvania	do	do	Bearded	5⅓	4	9	15½	7	17½	48⅔
24	Mediterranean Spring	Italy	Amber	do	do	6	5	10	14	9	19	50⅔
25	China Tea	Pekin	do	do	do	5	4½	12	18	7	21	56
26	Chili	Chili	White	do	Smooth	6½	5½	9	19⅓	9	17	45⅓
27	China Spring	Pekin	Amber	do	do	6	6	14	18	10	22	58⅔
28	Egyptian	Egypt	White	do	Bearded	6⅓	6	15	15⅔	10	18	48
29	Saxon Fife	Germany	Amber	do	Smooth	6½	5½	12	19½	6	24	64
30	Dominion	Virginia	do	Red	do	5	5	13	19	12	25	66⅔
31	Prussian	Prussia	White	White	do	5½	4½	14	14	10	19	50⅔
32	Golden Drop	Iowa	do	do	do	4½	6	14	17⅓	10	20	53⅓
33	Pringle's No. 6	Vermont	do	do	do	5	4⅔	10	19	5½	21	56
34	Pringle's No. 4	do	do	do	do	5⅓	6	15	17	6	17	45⅓
35	Pringle's No. 5	do	do	do	do	6	7	10	19	7	23	61⅓
36	Winter Australian	Australia	do	do	do	7	8	11	17½	8	19	50⅔
37	Clawson	Pennsylvania	White	Red	do	4½	8	17	24	11	29	77⅓
38	Fultz	do	Red	White	do	4⅔	6½	15	23	13	31	82⅔
39	Midge Proof	Wisconsin	White	do	do	4⅓	5	6	14	6	23	61⅓
40	Black Centennial	New South Wales	do	do	Bearded	5	9	10	25	3	24	64

41	Hedgerow	Egypt	do	do	Smooth	4	7½	6	17	5	18	48
42	Blount's No. 9	(Made here)	do	do	do	3	8	8	19½	7	20	53⅓
43	Italian	Italy	do	do	Bearded	4	5	9	15	8	17	45⅔
44	New York Flint	Genesee	do	do	Smooth	5½	7½	6	17½	6	19	50
45	Bald Baltic	Berlin	do	do	do	6	4⅔	8	14	8	16½	44
46	Illinois First Premium	Illinois	Amber			4	8½	8	17	6	18	48
47	Illinois Second Premium	do	do		Smooth	4	7	9	18½	2½	25	66⅔
48	Red Orange	do	Red			6	7½	14	19	11	21	56
49	Mediterranean Winter	France				5	6	7	17	7	18	48
50	Turkey	England				6½	5	8	16	9	17	45½
51	Blount's No. 10	(Made here)			Smooth		11	14	25½	8	23	61⅓
52	Golden Chaff	Iowa					4	9	17	8	18	48
53	Red Chaff Mediterranean	do					7	8	15	7	16	42⅔
54	Velvet Chaff	do	Red		Smooth		5½	6	16	8	19	50⅔
55	Turkey	Adrianople			do		7	8	18	8	18	48
56	Blount's No. 13	(Made here)			do		8	9	17	7	17	45⅓
57	Blount's No. 15	do			Bearded		7	8	14½	8	21	56
58	Blount's No. 16	do			Smooth		6½	5	19	7	15	40
59	Blount's No. 17	do			Bearded		7	7	20	8	21	56
60	Blount's No. 18	do			do		9	7	18½	6	21	56
61	Blount's No. 19	do			Smooth		7½	14	20½	6	18	48
62	Blount's No. 21	do			Bearded		8	4	19	7	16	42⅔
63	Black Chaff	Hungary			do		4½	5	15	8	17	45⅓
64	Cretan	Crete	White		do		5	3	14	5	20	53⅓
65	Andriola Red	Italy	Red		do		6	8	18	7	21	56
66	Andriola Amber	do	do		do		7	21	20	11	23	61⅓
67	Purple Chaff	Spain	do		do		6½	3	16	3	24	64
68	Boughton	Virginia	White		Smooth		7	1	20½	6	18	48
69	Hedgerow	Leipzig	do		do		6	14	17	8	21	56
70	Anantka	Poland	do		Bearded		5½	5	16	4	15	40
71	Fountain	Montana	do		Smooth		7	13	24	8	20	53⅓
72	Palestine	Palestine	Red		do		7	6	23	9	15	40
73	White Chaff	S. O.	do		do		5½	18	14	8	20	53
74	do	B. O.	do		Bearded		6	13	15	8	15	40
75	Red Chaff	do	do		do		5	15	14	9	15	40
76	Perfection	New York	White		Smooth			6	22	7	13	34⅔
77	German Fife	Berlin	Red		Bearded			7	23	7	21	56
78	Mammoth	do	White		Smooth			9	21½	9	19	50⅔
79	Triticum	St. Petersburg	do		Bearded			12	14	10	17	45⅓
80	Samara	Saratow	Amber		do			6	18	6	19	50⅔
81	Durum	Amoor	White		do			3	17	5	18	48
82	Saratow	Saratow	Red		do			12	16½	9	17½	46⅔
83	Ames	Moscow	Amber		do			7	16	9	18	48
84	Moscow	do	Red		do			6	17	5	15	40
85	Knap	Urals	do		Smooth			8	19½	10	17⅓	46⅔
86	Scotch Fife	Scotland	do		do			8	20	6½	17½	46⅓
87	Doty	Volga	do		Bearded			10	18	11	21	56
88	Meekius	Azor	do		do			7	21	10	22	58⅔
89	White Michigan	Michigan	do		Smooth			2	19½	6	20	53⅓
90	Rickenbrode	Pennsylvania			do			17	19	11	24	64
91	Red Siberian	Siberia	Red					19	20	10	21	56

Names, sources of seed, yield, &c., of Colorado wheat—Continued.

No.	Name of wheat.	Seed received from—	Color.		Bearded or smooth.	Yield per square rod, pounds.						Bushels per acre, 1884.
			Grain.	Chaff.		1879.	1880.	1881.	1882.	1883.	1884.	
92	Heige's Prolific	Pennsylvania	Amber		Smooth			14	22	12	24	64
93	Blue Beard	Black Sea	do					3	18	20	22	58⅔
94	Rice	Maryland			Smooth				12	12	17½	46⅔
95	Swamp	Tennessee			Bearded				9	8	24⅓	65¼
96	Gold Medal	Canada			Smooth				11	13	24	64
97	Glass	Pennsylvania			do				12	11	27	72
98	German Amber	Germany			do				11	10	23	61⅛
99	Wysor	Virginia			do				9	7	18	48
100	Dallas	Texas			do				8	13	17½	46⅔
101	Champion Amber	Pennsylvania			do				7	11	21	56
102	Finlay	Canada			do				10	10	23	61⅓
103	Lemon	Pennsylvania			do				8½	9	24	64
104	McGee's Red	Virginia			Bearded				9	8	15	40
105	Bennett	West Virginia			do				11	11	29	77⅓
106	Early May	Alabama	Red						8	8	16	42⅔
107	Rocky Mountain	California							6	7	17	45⅓
108	Silver Chaff	Kansas							7½	9	18	48
109	Blue Stem	Pennsylvania	White						9	4	18½	52⅔
110	Propos	California	do		Smooth				7	7	21	56
111	Small Frame	Kansas							5	9	17	45⅓
112	Red Clawson	Virginia			Smooth				6	9	22	58⅔
113	Yellow Missouri	Missouri							3	11	18	48
114	Walker	Georgia	Red						8	10	13	34⅔
115	Utah	Salt Lake	White						6	2	17	45⅓
116	Zimmerman	Ohio	Red						8	7	19	50⅔
117	Big May	do			Smooth				7	10	21	56
118	Blount's No. 22	(Made here)							6	3	18	48
119	Blount's No 23	do			Smooth				7	4	21	56
120	Blount's No. 24	do			do				7	2	22	58⅔
121	Blount's No. 25	do			do				8	4	19	50⅔
122	Blount's No. 26	do			do				7	4	22	58⅔
123	Blount's No. 27	do			do				9	2	19	50⅔
124	Blount's No. 28	do			do				8	3	23	61⅓
125	Blount's No. 29	do			do				7	3	17	45⅓
126	Blount's No. 30	do			do				8	3	19	50⅔
127	Blount's No. 31	do							7	3	18	48
128	Blount's No. 32	do							9	2	20	53⅓
129	Blount's No. 33	do			Smooth				10	3	17	45⅓
130	Blount's No. 34	do			Bearded				5	2	15	40
131	Casaca	Spain			do				8	1	16	42⅔

132	Califat	New Zealand				8	3	17½	46⅝
133	Tuscau	do				7	4	15	40
134	Essex	do				9	3	13	34⅜
135	Tuskana	do				8	3	16½	44
136	Pearl	do				7	4	18	48
137	Hunter's	do				6	4	16	50⅞
138	W. C. Red	Pennsylvania				7	6	16	42⅜
139	Square-head Essex	England				8	2	13	34⅜
140	Gold Drop	do				7	1	15	40
141	Blue Chaff	do				6	2	13	34⅜
142	Chiddum	do				5	2	15	40
143	Venice	Italy				4	4	13½	36
144	Apeonine	do				4	3	17	45½
145	R. Oregon Club	Oregon		Bearded		5	6	17½	46⅜
146	Hedgerow	do		Smooth		8	3	17	45½
147	Aowse	Montana	White	do		8	5	22	58⅜
148	Monmouth	Illinois		Bearded		6	5	18	48
149	Russian Sprieg	Winnipeg	Red	Smooth		7	7	20	53½
150	Vermilion	do		do		8	3	17½	46⅜
151	Smoky	do	Red	Bearded		9	4	20	53½
152	Edenton Fife	do	do	Smooth		5	6	18	48
153	Nox No. 2	Vermont	White	do		3	3½	17½	46⅜
154	Nox No. 1	do	do	do		7	6	17	45⅜
155	Nox No. 4	do	Red	Bearded		6	3	21	56
156	Nox No. 3	do	Amber	do		8	2	15	40
157	Nox No. 5	do	White	Smooth		7	4½	18	48
158	Pringle's No. 17	do	do	do		5½	5	17	45⅜
159	Pringle's No. 26	do	do	do		9	2	16	42⅔
160	Wales	New South Wales	Amber	do		8	4	18	48
161	Dead Sea	Palestine				7	3	17	45⅜
162	Northcote's Improved	Washington Territory	White	Smooth		8	5	15	40
163	Northcote's Amber	do	Amber	do		6	5	16½	44
164	White May	Alabama				1	13		34⅜
165	Cat Mountain	California	Red			3	15		40
166	Reed Straw	Ohio				1	14		37⅛
167	Cayahuga	New York				1	13		34⅜
168	Black Chaff	Russia	Red	Smooth		1	16		42⅔
169	Blount's No. 35	(Made here)		do		1	17		45⅜
170	Velvet Amber	Ohio				1	15		40
171	Hebron	Jerusalem	Amber			7	19		50⅜
172	Blount's No. 36	(Made here)				1	16		42⅔
173	White Mediterranean	France	White	Smooth		7	18		48
174	Red Mediterranean	do	Red			6	17		45⅜
175	French Imperial	do	do	do		7	24		64
176	Nebraska	Nebraska	White	Bearded		3	17		45⅜
177	White	North Carolina	do	Smooth		1	20		53⅓
178	Kivet	do	Amber	do		5	26		69⅓
179	Rust Proof	do	Red	do		6	20		53⅓
180	Baltimore	do	White	do		2	18		48
181	Davis	do	Red	do		3	32		85⅓
182	Purple Straw	do	do	do		7	27		72

Names, sources of seed, yield, &c., of Colorado wheats—Continued.

No.	Name of wheat.	Seed received from—	Color.		Bearded or smooth.	Yield per square rod, pounds.						Bushels per acre, 1884.
			Grain.	Chaff.		1879.	1880.	1881.	1882.	1883.	1884.	
183	Gold Premium	North Carolina	White		Smooth					4	32½	86⅔
184	Hick's Prolific	do	Red		do					3	20	53⅓
185	Earnhart	do	White		do					2½	22	58⅔
186	Wintergreen	do	do		do					2	21	56
187	St. Leger	Scotland								1	18	48
188	Cheshire	do								1	15	40
189	Hunter	do								2	17	45⅓
190	Oakshotts	do								1	18	48
191	Hardwick	do								3	19	50⅔
192	Geiger	Divide	White		Smooth					5	16	42⅔
193	Blount's No. 37	(Made here)								6	17½	46⅔
194	Sea Island	Washington			Bearded					1	17	45⅓
195	Edenton	Winnepeg			do					2	15	40
196	Winnepeg Russian	do	Red		Smooth					2	15½	41⅓
197	Manitoba	do	do		Bearded					2	15	40
198	Winnepeg	do	Amber		do					1	15	40
199	Russia Wionepeg	do	Red		Smooth					3	16	42⅔
200	Hallet's Pedigree	England	White		do					2	17	45⅓
201	Sibley's No. 1	Rochester			Bearded					2	14	37⅓
202	French Black Chaff	France			do					2	15	40
203	Rural	New York			do						12	32
204	Velvet Club	Germany									10	26⅔
205	Austrian	Austria									9	23
206	Bohemian	Bohemia									7	19⅓
207	Whittington	California									10	26⅔
208	Snow Flake	do			Smooth						9	23
209	Beardless Velvet	do									8	21⅓
210	Tagaurog	do									7	19⅓
211	Michigan Amber	Michigan	Red								11	29⅓
212	China No. 1	Pekin			Bearded						8	21⅓
213	China No. 2	do									9	23
214	Missouri Turkey	Missouri			Bearded						7	19⅓
215	Missouri Mediterranean	do			do						11	29⅓
216	California Walker	California			do						9	23
217	Ohio White	Ohio									13	34⅔
218	India Red	India									10	26⅔
219	Andrus Black	New York									7	19⅓
220	Mediterranean Hybrid	do									11	29⅓
221	Andrus Flint	do									6	16
222	Scottish Fife	Washington			Smooth						12	32

223	Rye	Hungary				do						8	
224	Frankenstein	Germany				do						7	
225	March	California										11	
226	Flanders	Flanders										12	
227	Flourelle	France										9	
228	Victoria	England										8	
229	Circassian	Circassia										11	
230	W. Velvet	Ireland										14	

Of his method of cultivation Professor Blount says:

It is quite simple. I sow only one ounce of picked seed per square rod in eight rows, or in field culture only thirty pounds per acre. On each square rod I put home-made fertilizers, horse, cow, hog, and sheep manure, the latter being by far the best in this climate. In the case of cow and hog manures, one cubic foot is used, but two cubic feet of horse manure. There are also plots with no manures. My crops are hoed twice and irrigated twice.

Of the seasons he says:

1879 was a fair wheat year, no rain from April to harvest; 1880 two showers, doing more damage to wheat than none; 1881 and 1882 fair wheat seasons; 1883 hail killed everything, and 1884 a fine season with some rain.

A description of his methods of crossing and selection will be found in the Annual Report of this Department for 1881–'82, and in the report of the agricultural department of the Colorado State College for 1884.

In addition it is necessary to say that it must be borne in mind that these wheats have been grown upon an experimental scale and with greater care and regularity of condition than could be often found in field culture in this country. While they do not represent, therefore, the ordinary product of the State from which they come, they are more valuable for purposes of scientific comparison and as a guide to what may be done by the farmer in the improvement of his seed and crops.

Physical properties of Colorado wheat, 1884.

Name.	Collection number.	Serial number.	Color.	Bearded or smooth.	Yield per acre.	Weight per bushel.	Weight per 100 grains.	Years in cultivation.
					Bus.	*Lbs.*	*Grains.*	
Oregon Club	10	3500	Light amber	S.	50⅔	63.7	3.647	6
Australian Hard	11	3501	....do	S.	52	.....	4.041	6
Sonora	12	3502	Yellow	S.	56	67.3	3.830	6
White Mexican	13	3503	....do	S.	41¼	63.5	4.890	6
Improved Fife	14	3504	Light amber	S.	56	65.8	3.672	6
Brooks	16	3505	Amber	S.	50⅔	65.0	3.841	6
Rio Grande	17	3506	... do	B.	56	67.1	4.743	6
Canada Club	18	3507	....do	S.	50⅔	66.1	3.764	6
Judkin	19	3508	Dark amber	S.	53⅓	64.1	3.920	6
Lost Nation	20	3509	Amber	S.	41⅓	64.5	4.147	6
Touzelle	21	3510	Lighter amber	B.	45⅓	65.7	4.300	6
Australian Club	22	3511	Amber white	S.	50⅔	64.8	4.536	6
Golden Globe	23	3512	Amber	B.	48⅝	66.5	4.670	6
Mediterranean Spring	24	3513	....do	B.	50⅔	66.2	4.640	6
China Tea	25	3514	do	B.	56	67.0	5.000	6
Chili	26	3515	Yellow	S.	45⅓	64.9	4.440	6
China Spring	27	3516	Dark amber	S.	58⅔	65.4	3.990	6
Egyptian Fife	28	3517	Yellow amber	B.	48	63.8	4.840	6
Saxon Fife	29	3518	Red	S.	64	65.3	3.690	6
Daonuian	30	3519	Red and yellow	S.	66⅔	62.5	4.110	6
Prussian	31	3520	Dark amber	S.	50⅔	64.6	3.610	6
Pringle	34	3521	Light amber	S.	45⅓	.....	4.300	6
Hedge Row, White Chaff	41	3522	Yellow amber	S.	48	65.9	3.170	6
Italian	43	3523	Red and yellow	B.	45⅓	64.1	5.620	6
Hybrid No. 10	51	3524	Pale yellow	S.	61⅓	63.9	4.690	5
Nox No. 1	54	3525	Yellow and amber	S.	50⅔	64.8	3.980	5
Hybrid No. 13	56	3526	Amber	S.	45⅓	62.7	3 160	5
Hybrid No. 15	57	3527	Yellow and amber	B.	56	63.6	3.200	5
Hybrid No. 16	58	3528	Red and amber	S.	40	62.8	4.110	5
Hybrid No. 17	59	3529	Red	B.	56	66.8	4.740	5

Physical properties of Colorado wheat, 1884—Continued.

Name.	Collection number.	Serial number.	Color.	Bearded or smooth.	Yield per acre.	Weight per bushel.	Weight per 100 grains.	Years in cultivation.
					Bus.	*Lbs.*	*Grains.*	
Andriola Arobei	66	3530	Red and amber	B.	61⅛	66.4	3.790	5
Red Clawson	112	3531	Dark amber	S.	58⅝	66.0	3.660	3
Big Mary	117	3532	Dark yellow	S.	56	63.5	4.710	3
Hybrid No. 26	122	3533	Light amber	S.	58⅝	65.9	5.339	3
Hybrid No. 28	124	3534	Dark yellow	S.	61⅛	62.2	4.683	3
Hybrid No. 33	129	3535	do	S.	45⅛	62.8	3.586	3
Hybrid No. 34	130	3536	Glassy amber	B.	40	64.4	6.620	3
Casaca	131	3537	Red	B.	42⅝	....	3.299	3
Monmouth	148	3538	Light red	B.	48	67.0	4.830	3
Russian Spring	149	3539	Red	S.	53⅛	64.3	3.880	3
Vermillion	150	3540	do	S.	46⅝	64.9	3.500	3
Edenton Fife	152	3541	do	S.	48	63.5	4.100	3
Nox 2	153	3542	Yellow amber	S.	46⅝	65.7	4.170	3
Nox 4	155	3543	Light red	B.	56	66.1	4.670	3
Nox 3	156	3544	Glassy amber	B.	40	67.2	5.505	3
Nox 5	157	3545	Yellow amber	S.	48	65.0	4.239	3
Pringle No. 17	158	3546	do	S.	45⅝	64.2	4.167	3
Wiles	160	3547	Light amber	S.	48	64.6	5.073	3
Northcote's Imperial	162	3548	Yellow	S.	40	63.7	3.576	3
Northcote's Amber	163	3549	Light red	S.	44	64.1	4.120	3
Black Chaff	168	3550	Red	S.	42⅜	66.7	3.420	2
Hybrid No. 35	169	3551	Amber yellow	S.	45⅝	62.2	3.800	2
Hebron	171	3552	do	S.	50⅝	63.9	3.500	2
Mediterranean White	173	3553	Deep yellow	S.	48	66.9	3.580	2
French Imperial	175	3554	Red	S.	64	66.6	4.880	2
Nebraska	176	3555	Amber	B.	45⅜	66.4	4.440	2
Northcote's White	177	3556	Light amber	S.	53⅜	64.6	4.400	2
Kivet	178	3557	Deep yellow	S.	69⅛	65.0	4.220	2
Baltimore	180	3558	Light red	S.	48	67.1	5.060	2
Davis	181	3559	do	S.	85⅛	66.1	4.220	2
Gold Premium	183	3560	do	S.	86⅝	65.7	4.120	2
Hick's Prolific	184	3561	Red	S.	53¼	66.1	3.890	2
Wintergreen	186	3562	Amber	S.	56	66.9	3.930	2
Geiger	192	3563	do	S.	42	.....	4.240	2
Hybrid No. 37	193	3564	Amber yellow	....	46⅝	64.2	3.850	2
Sea Island	194	3565	Red	B.	45⅝	.....	3.420	2
Edenton	195	3566	Amber	B.	40	65.6	5.180	2
Winnipeg, Russian	196	3567	Light red	S.	41⅝	64.4	4.120	2
Manitoba	197	3568	Red	B.	40	66.3	3.580	2
Winnipeg	198	3569	Glassy amber	B	40	67.8	5.560	2
Hallett's Pedigree	200	3570	Amber and yellow	S.	45⅝	64.5	3.880	2
China No. 2	213	3571	Amber	.....	24	67.7	3.180	1
Mo. Turkey	214	3572	do	B.	18⅝	.....	4.000	1
Mo. Mediterranean	215	3573	Light red	B.	29¼	.....	4.480	1
Scotch Fife	222	3574	Red	S.	32	64.6	3.440	1
Rye	223	3575	Dark and light red	S.	21⅓	64.7	4.760	1
Sandomirka	233	3576	Dark red	.....	.....	68.6	4.060	1
Hopetown	235	3577	Amber	.....	.....	67.0	4.500	1

Analyses of Colorado wheat, 1874.

Name.	Collection number.	Serial number.	Color.	Weight of 100 grains.	Water.	Ash.	Oil.	Carbohydrates.	Fiber.	Albuminoids.	Nitrogen.	Season of growth.	Gluten.		Quality of gluten.
													Moist.	Dry.	
				Grams.	*Pr ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*				
Oregon Club	10	3500	Light amber	3.647	6.93	1.98	2.13	75.58	2.18	11.20	1.79	6	23.75	8.71	
Australian Hard	11	3501	do	4.041	7.46	2.05	1.95	74.76	2.05	11.73	1.88	6	32.20	11.81	
Sonora	12	3502	Yellow	3.830	7.31	1.90	2.27	74.64	1.63	12.25	1.96	6	36.18	13.37	
White Mexican	13	3503	do	4.890	7.27	2.05	1.94	75.69	1.50	11.55	1.85	6	35.01	12.70	
Improved Fife	14	3504	Light amber	3.672	8.72	1.78	2.24	71.18	1.90	14.18	2.27	6	45.12	16.16	
Brooks	16	3505	Amber	3.841	6.68	1.80	1.96	74.55	1.88	13.13	2.10	6	38.72	13.70	
Rio Grande	17	3506	do	4.743	8.74	1.52	2.49	72.92	1.90	12.43	1.99	6	32.83	11.76	
Canada Club	18	3507	do	3.764	7.85	1.87	2.14	74.11	1.60	12.43	1.90	6	28.65	10.80	
Judkin	19	3508	Dark amber	3.920	7.63	1.94	2.27	74.06	1.85	12.25	1.96	6	30.45	11.28	
Lost Nation	20	3509	Amber	4.147	7.29	1.53	2.25	75.49	1.45	12.08	1.93	6	27.70	10.12	
Touzelle	21	3510	Light amber	4.309	6.98	1.79	1.94	73.63	1.48	14.18	2.27	6	44.64	14.88	
Australian Club	22	3511	Mixed amber and white	4.536	7.16	1.16	1.98	76.97	1.18	11.55	1.85	6	27.49	9.39	
Golden Globe	23	3512	Amber	4.670	7.08	1.97	2.67	72.89	1.65	13.83	2.21	6	35.91	13.21	
Mediterranean Spriog	24	3513	do	4.649	7.53	1.69	2.61	73.27	1.60	13.30	2.13	6	34.73	10.49	
China Tea	25	3514	do	5.000	7.38	1.18	2.58	74.48	1.25	13.13	2.10	6	19 44	10.25	
Chili	26	3515	Yellow	4.440	6.55	1.61	2.02	77.16	1.28	11.38	1.82	6	35.35	13.34	
China Spring	27	3516	Dark amber	3.900	6.39	1.23	2.49	74.24	1.65	14.90	2.24	6	31.96	11.60	
Egyptian Fife	28	3517	Yellow and amber	4.849	6.98	1.61	2.11	75.64	1.23	12.43	1.99	6	27.81	10.32	
Saxon Fife	29	3518	Red	3.690	6.51	1.28	2.38	73.98	1.50	14.35	2.30	6	39.59	14.63	
Dominion	30	3519	Red and yellow	4.110	6.26	1 75	2.22	74.84	1.63	13.30	2.13	6	41.29	14.62	
Prussian	31	3520	Dark amber	3.610	7.01	1.91	1.22	76 61	2.10	10.15	1.62	6	29.02	9.35	
Priogle	34	3521	Light amber	4.300	6.97	1.85	2.24	75.09	1.95	11.90	1.90	6	25.42	8.44	
White Chaff Hedgerow	41	3522	Yellow and amber	3.179	5.95	1.50	2.43	78.85	1.29	9.98	1.60	6	33.62	11.81	
Italian	43	3523	Red and yellow	5.920	6.92	1.91	2.17	75.50	1.60	11.90	1.90	6	24.22	8.19	
Hybrid No. 10	51	3524	Pale yellow	4.090	6.57	1.75	1.78	78.69	1.85	9.45	1.51	5			
Nox No. 1	54	3525	Yellow and amber	3.980	6.35	1.62	2.08	77.07	1.33	11.55	1.85	5	27.98	9.83	
Hybrid No. 13	56	3526	Amber	3.160	7.13	1.78	2.59	74.07	1.48	12.95	2.07	5	34.18	12.44	
Hybrid No. 15	57	3527	Yellow and amber	3.200	8.19	1.75	2.32	74.23	1.43	12.03	1.93	5			
Hybrid No. 16	58	3528	Red and amber	4.110	7.04	1.95	2.27	75.78	1.58	11.38	1.82	5	41.60	13.12	
Hybrid No. 17	59	3529	Red	4.740	7.00	1.60	2.55	75.45	1.15	12.25	1.96	5	39.68	14.04	
Andriola Amber	66	3530	Red and amber	3.790	8.07	1.90	2.61	71.64	1.60	14.18	2.27	5	36.30	12.83	
Red Clawson	113	3531	Dark amber	3.660	7.51	1.85	2.19	74.06	1.61	12.78	2.04	3	38.00	13.24	
Big Mary	117	3532	Dark yellow	4.710	7.16	2.05	2 09	75.87	1.63	11.20	1.79	3	28.45	9.96	
Hybrid No. 26	122	3533	Light amber	5.339	8.12	1.95	2.01	74.39	1.45	12.08	1.93	3	36.60	12.01	
Hybrid No. 28	124	3534	Dark yellow	4.683	9.15	2.10	2 32	73.43	1.80	11.20	1.79	3	33.01	11.63	
Hybrid No. 33	129	3535	do	3.586	8.79	1.84	2.31	76.30	1.75	9.80	1.57	3	26.06	9.24	
Hybrid No. 34	130	3536	Amber, glassy, and sbriveled	6.620	8.42	2.25	1.99	73.31	1.95	12.08	1.93	3	33.49	11.70	
Casaca	131	3537	Red	3.299	8.65	2.10	2.55	73. 9	1.68	11.73	1.88	3	38.64	12.94	
Monmouth	148	3538	Light red	4.830	8.24	2.05	2.68	72.70	1.55	12.78	2.04	3	35.32	12.82	
Russian Spring	149	3539	Red	3.880	8.41	1.95	2.36	72.01	1.79	13.48	2.16	3	35.26	13.00	Good.
Vermillion	150	3540	do	3.500	7.84	2.00	2.34	71.49	1.63	14.70	2.35	3	35.90	12.89	

Edenton Fife	152	3541	do	4.0100	9.33	1.93	2.50	71.30	1.64	13.30	2.13	3	37.09	12.92	
Nox 2	153	3542	Yellow and amber	4.1700	7.52	2.30	2.16	75.34	1.30	11.38	1.82	3	36.50	12.82	
Nox 4	156	3543	Light red	4.6700	8.13	1.65	2.51	74.51	1.30	11.90	1.90	3	29.90	10.29	
Nox 3	156	3544	Amber, glassy, and shriveled	5.5055	8.43	2.05	2.80	70.79	1.40	14.53	2.32	3	37.86	14.40	
Nox 5	157	3545	Amber and yellow	4.2390	8.48	1.45	2.21	74.31	1.30	12.25	1.96	3	32.62	11.32	
Pringle No. 17	158	3546	Yellow and amber	4.1670	7.94	2.00	2.73	73.03	1.70	12.60	2.02	3	34.25	12.28	Poor.
Wales	160	3547	Light amber	5.0735	7.74	1.50	1.97	76.39	1.55	10.85	1.74	3	29.64	9.59	Good.
Northcotes Improved	163	3548	Yellow	3.5760	7.66	1.95	1.34	75.62	1.93	10.50	1.68	3	12.30	4.21	Very bad.
Northcotes Amber	164	3549	Light red	4.1200	7.46	2.05	2.38	76.01	1.25	10.85	1.74	3	29.04	9.64	Good.
Black Chaff	168	3550	Red	3.4200	8.28	1.60	2.03	75.54	1.35	11.20	1.79	2	30.77	10.87	Puffy.
Hybrid No. 35	169	3551	Amber and yellow	3.8000	7.53	1.50	2.42	76.57	1.48	10.50	1.68	2	29.59	10.18	Medium.
Hebren	171	3552	do	3.5000	7.69	2.10	1.90	72.96	1.35	14.00	2.24	2	33.01	12.23	Do.
Mediterranean White	173	3553	Deep yellow	3.5800	7.74	1.75	1.95	73.93	1.50	13.13	2.10	2	33.69	11.83	
French Imperial	175	3554	Red	4.8800	7.00	2.00	2.76	73.99	1.65	12.60	2.02	2	17.15	7.05	Very bad.
Nebraska	176	3555	Amber	4.4400	7.08	2.15	2.10	72.86	1.98	13.83	2.21	2	37.46	12.49	Medium good.
White North Carolina	177	3556	Light red	4.4000	6.90	1.50	2.52	74.20	1.75	13.13	2.10	2	31.14	11.12	Do.
Kivet	178	3557	Deep yellow	4.2200	7.18	1.95	2.35	72.57	1.95	14.00	2.24	2	34.58	12.19	Do.
Baltimore	180	3558	Light red	5.0600	7.06	2.05	2.29	74.45	1.55	12.60	2.02	2	31.83	11.68	Medium.
Davis	181	3559	do	4.2200	7.12	1.95	1.98	72.71	1.38	14.88	2.38	2	43.18	13.08	Good.
Gold Premium	183	3560	do	4.1200	6.80	1.95	2.56	72.94	1.75	14.00	2.24	2	36.68	12.46	Do.
Hicks Prolific	184	3561	Red	3.8900	6.88	1.45	2.10	75.04	1.75	12.78	2.02	2	33.29	11.48	Do.
Winter green	186	3562	Amber	3.9300	7.11	1.35	1.95	74.91	1.38	13.30	2.13	2	39.07	13.43	Do.
Geiger	192	3563	do	4.2400	6.23	2.00	2.25	74.81	1.58	13.13	2.10	2	35.57	12.57	Medium good.
Hybrid No. 37	193	3564	Amber and yellow	3.8500	6.08	2.05	2.58	75.26	1.78	12.25	1.96	2	29.25	11.11	Very bad.
Sea Island	194	3565	Red	3.4200	6.77	1.40	2.07	75.75	1.58	12.43	1.99	2	31.96	11.58	Medium.
Edenton	195	3566	Amber	5.1800	7.69	1.65	2.56	74.25	1.85	12.60	2.02	2	31.05	11.18	Do.
Winnipeg Russian	196	3567	Light red	4.1200	9.17	2.15	2.52	72.25	1.83	12.08	1.93	2	33.49	11.62	Shriveled.
Manitoba	197	3568	Red	3.5800	8.09	2.05	3.36	73.45	1.80	12.25	1.96	2	34.40	14.29	Poor.
Winnipog	198	3569	Deep amber, yellow, glassy	5.5600	7.39	2.00	2.84	71.81	1.78	14.18	2.27	2	32.46	13.03	Do.
Hallet's Pedigree	200	3570	Amber and yellow	3.8800	8.31	.....	2.63	....	1.95	12.08	1.93	2	22.90	9.31	Bad.
China No. 2	213	3571	Amber	3.1800	8.94	2.35	2.20	69.71	1.75	15.05	2.41	1	41.82	14.60	Good.
Mo. Turkey	214	3572		4.0000	.....	.....	.....	.....	1.32	12.25	1.96	1	.....	.....	
Mo. Mediterranean	215	3573	Light red	4.4800	8.68	2.15	2.21	71.21	1.75	14.00	2.24	1	36.96	13.87	Very good.
Scottish Fife	222	3574	Red	3.4400	8.13	1.90	2.50	71.67	1.80	14.00	2.24	1	48.25	16.97	Do.
Rye	223	3575	Dark and light red	4.7600	7.96	1.95	2.04	73.03	1.72	13.30	2.13	1	.....	.....	
Sandomirka	233	3576	Dark red	4.0600	7.54	2.00	2.36	73.25	1.90	12.95	2.07	1	.....	.....	
Hopetown	235	3577	Amber	4.5000	8.97	.95	2.17	72.53	2.08	13.30	2.13	1	.....	.....	

The data in the preceding tables have been averaged for comparison with the averages of previous years as well as of those wheats which had been grown different lengths of time in Colorado.

Average composition of Colorado wheat grown in 1884.

	Number.	Weight per bushel.	Weight per 100 grains.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Gluten.	
											Moist.	Dry.
		Lbs.	*Grams.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. et.*	*P. ct.*	*P. ct.*	*P. ct.*
All varieties....	77	65.2	4.222	7.54	1.81	2.29	74.19	1.64	12.53	2.00	33.31	10.42
Sixth season....	24	65.2	4.408	7.15	1.70	2.24	74.83	1.64	12.44	1.99	32.90	10.31
Fifth season....	7	64.4	4.167	7.19	1.75	2.32	75.27	1.49	11.98	1.92	35.75	12.45
Third season	19	64.7	4.402	8.11	2.01	2.34	73.90	1.59	12.05	1.93	34.33	12.05
Second season ..	21	65.6	3.968	7.34	1.81	2.32	73.96	1.67	12.90	2.06	32.50	11.65
First season	7	66.5	4.203	8.37	1.88	2.25	71.90	1.83	13.77	2.20	42.68	15.15

The average for the seventy-seven varieties grown in 1884 when compared with that of other years shows that in size and percentage of albuminoids, although there has been an advance over 1883, the wheats of that year are not equal to those of 1881 and 1882.

Average composition of Colorado wheats.

	1881.	1882.	1883.	1884.
Weight of 100 grains.....grams..	4.865	4.283	3.941	4.222
Water.....per cent..	9.86	8 80	9.38	7.54
Ash.....do ..	2.28	1.99	2.09	1.81
Oil.....do....	2.41	2.38	.....	2.29
Carbhydrates.....do....	70.48	72.03	76.79	74.19
Crude fiber.....do...	1.57	1.76	.. ....	1.64
Albuminoids.....do....	13.40	13.04	11.74	12.53
Total.....	100.00	100.00	100.00	100.00
Nitrogen.....do....	2.14	2.09	1.88	2.00
Moist gluten.....do....	33.12	34.69	.....	33.31
Dry gluten.....do...	11.74	12.89	.....	10.42

It would perhaps be unsafe to draw any definite conclusions from these averages, but they would seem to show that peculiarities of season are most influential on the composition of the grain.

Examined in connection with the individual analyses and with regard to the characteristics of the several seasons of growth it would appear that the low percentage of albuminoids in 1884 may be due to the fact that having fallen to 11.74 in 1883, the wheats were unable to recover more than to 12.53 in 1884. If this is the case the effects of this bad season and set back in 1883 may be overcome in 1885. Analysis of that year's crop will decide this.

Then, the inquiry may be made as to what influence on this average is due to the continued growth of the grain on one soil for a number of years. To examine this question the averages by seasons of growth were calculated. From these one learns that the wheats of the first two seasons growth are richer in albuminoids than those which have been raised a longer time in Colorado. In the case of the wheats grown for

the first time in the State the higher figures are probably due to the fact that the seed had not been injured by the hailstorm which had affected the others, and they therefore produced a grain as rich as that from seed introduced in 1881 and 1882. Why, however, there should be a decrease from the second to the fifth season and increase in the sixth is not so easy to say. The difference is small and may be due to peculiarities in the varieties rather than other conditions.

To discover what the deterioration may have been for particular varieties the analyses of all wheats which have been made more than once are tabulated together on the following page:

Name.	Collection number.	Serial number.	Color.	Weight of 100 grains.	Water.	Ash.	Albuminoids.	Nitrogen.	Seasons.	Number of seasons.
				Grms.	*P. ct.*	*P. c.*	*P. ct.*	*P. c.*		
Oregon Club	10	738	Yellow	4.434	9.59	1.91	12.25	1.96	1881	3
Do	10	2127	....do	3.714	8.75	2.10	11.38	1.82	1883	5
Do	10	3500	Light amber	3.647	6.93	1.98	11.20	1.79	1884	6
Australian Hard	11	731	Yellow	5.506	9.78	1.85	11.19	1.79	1881	3
Do	11	3501	Light amber	4.041	7.46	2.05	11.73	1.88	1884	6
Sonora	12	739	Yellow	4.739	10.17	2.02	14.18	2.27	1881	3
Do	12	2133	....do	3.618	9.12	1.96	12.78	2.04	1883	5
Do	12	3502	...do	3.830	7.31	1.90	12.25	1.96	1884	6
White Mexican	13	729	....do		9.91	2.60	13.81	2.21	1881	3
Do	13	2128	....do	4.442	8.35	2.20	11.90	1.90	1883	5
Do	13	3503	... do	4.890	7.27	2.05	11.55	1.85	1884	6
Improved Fife	14	2129	Amber	3.784	9.28	2.04	13.83	2.21	1883	5
Do	14	3504	Light amber	3.672	8.72	1.78	14.18	2.27	1884	6
Rio Grande	17	735	Red	5.906	9.51	2.08	14.69	2.35	1881	3
Do	17	2134	do	4.162	8.89	2.03	12.95	2.07	1883	5
Do	17	3506	Amber	4.743	8.74	1.52	12.43	1.99	1884	6
Judkin	19	730	Red		9.75	2.57	12.25	1.96	1881	3
Do	19	2137	Amber	3.761	9.13	1.91	11.55	1.85	1883	5
Do	19	3508	Dark amber	3.920	7.63	1.94	12.25	1.96	1884	6
Lost Nation	20	741	Red	3.851	10.24	2.17	12.93	2.07	1881	3
Do	20	2139	Amber	3.739	9.93	1.87	11.55	1.85	1883	5
Do	20	3509	....do	4.147	7.29	1.53	12.08	1.93	1884	6
Touzelle	21	736	Yellow	5.214	10.23	2.10	13.50	2.16	1881	3
Do	21	2141	. do	4.247	10.73	2.12	13.30	2.13	1883	5
Do	21	3510	Light amber	4.300	6.98	1.79	14.18	2.27	1884	6
Australian Club	22	2142	Yellow	4.425	8.97	1.97	11.03	1.76	1883	5
Do	22	3511	Mixed amber and white	4.536	7.16	1.16	11.55	4.85	1884	6
Pringles No. 6	33	742	Yellow	5.145	9.89	2.12	13.13	2.10	1881	3
Do	33	2153	....do	4.651	9.30	2.08	13.65	2.18	1883	5
Pringles No. 7	34	743	Amber	4.636	9.89	2.23	15.25	2.44	1881	3
Do	34	2154	Yellow	3.968	9.15	2.05	12.08	1.93	1883	5
Centennial	40	727			9.66	2.35	12.06	1.93	1881	3
Do	40	2159	Yellow	5.878	8.60	2.10	11.55	1.85	1883	5
White Chaff, Hedge Row	41	745	....do	4.072	9.07	2.08	13.62	2.18	1881	3
Do	41	2160	do	2.838	9.16	2.02	11.73	1.88	1883	5
Do	41	3522	Yellow and amber	3.170	5.95	1.50	9.98	1.60	1884	6
Hybrid No. 10	51	719	Amber		9.72	2.28	13.75	2.20	1881	5
Do	51	2126	Yellow	5.024	8.68	2.26	11.03	1.76	1883	3
Do	51	3524	Pale yellow	4.690	9.57	1.75	9.45	1.51	1884	6
Hybrid No. 13	56	2189	Red	3.699	10.27	2.10	10.68	1.71	1883	4
Do	56	3526	Amber	3.660	7.13	1.28	12.95	2.07	1884	5
Hybrid No. 15	57	720	Red		10.07	1.93	12.25	1.96	1881	2
Do	57	2131	... do	3.572	8.87	2.03	11.73	1.88	1883	4
Do	57	3527	Yellow and amber	3.200	8.19	1.75	12.08	1.93	1884	5

Name.	Collection number.	Serial number.	Color.	Weight of 100 grains.	Water.	Ash.	Albuminoids.	Nitrogen.	Seasons.	Number of seasons.
				Grms.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*		
Hybrid No. 16	58	721	Red	4.824	9.53	2.04	11.75	1.88	1881	2
Do	58	2132	Amber	5.036	8.70	2.13	11.03	1.76	1883	4
Do	58	3528	Red and amber	4.110	7.04	1.95	11.38	1.82	1884	5
Hybrid No. 17	59	722	Amber	5.137	9.93	2.07	13.62	2.18	1881	2
Do	59	2135	Red	4.818	8.90	2.23	14.35	2.30	1883	4
Do	59	3529	....do	4.740	7.00	1.60	12.25	1.96	1884	5
Hedge Row, Red Chaff	69	746	Amber	4.499	9.17	2.59	12.94	2.07	1881	3
Do	69	2161	Yellow	4.008	9.18	2.19	12.95	2.07	1883	5
Fountain	71	732	... do	5.100	10.58	2.70	13.62	2.18	1881	3
Do	71	2162	....do	4.191	8.27	2.14	11.90	1.90	1883	5
White Chaff	74	747	Red	4.214	9.57	2.03	14.04	2.25	1881	3
Do	74	2163	do	3.252	7.95	2.05	12.08	1.93	1883	5
Perfection	76	733	Yellow	5.536	9.93	1.99	14.18	2.27	1881	2
Do	76	2164	....do	5.032	10.29	2.08	12.95	2.07	1883	4
German Fife	77	737	Red	5.368	10.42	2.31	15.06	2.41	1881	2
Do	77	2168	Amber	4.546	10.05	2.28	12.60	2.02	1883	4
Triticum	79	748	Yellow	5.754	10.02	2.67	13.62	2.18	1881	2
Do	79	2165	....do	4.861	8.98	2.02	14.00	2.24	1883	4
Russian Durum	81	749	Amber	5.924	9.91	2.32	15.25	2.44	1881	2
Do	81	2166	Yellow	4.761	8.70	2.10	14.35	2.30	1883	4
Meekin's	88	751	Red	5.193	9.38	2.53	15.15	2.43	1881	2
Do	88	2167	....do	4.414	10.15	2.05	13.48	2.16	1883	4
Hybrid No. 26	122	2146	Yellow	3.987	9.40	2.20	14.38	2.38	1883	2
Do	122	3533	Light amber	5.339	8.12	1.95	12.08	1.93	1884	3
Hybrid No. 28	124	2148	Yellow	3.827	9.32	2.28	9.98	1.60	1883	2
Do	124	3534	Dark yellow	4.683	9.15	2.10	11.20	1.79	1884	3
Hybrid No. 33	129	2152	Yellow	2.716	10.15	1.87	8.93	1.43	1883	2
Do	129	3535	Dark yellow	3.587	8.90	1.84	9.80	1.57	1884	3
Hybrid No. 34	130	2155	Amber	5.179	8.82	2.43	12.60	2.02	1883	2
Do	130	3536	Amber and glassy	6.620	8.42	2.25	12.08	1.93	1884	3
Russiao, Spring	149	2171	Amber	3.438	8.92	2.31	12.78	2.04	1882	1
Do	149	2172	.....do	3.985	9.68	2.14	12.25	1.96	1883	2
Do	149	3539	Red	3.880	8.41	1.95	13.48	2.16	1884	3
Hybrid No. 35	169	2156	Yellow	3.055	9.37	2.27	10.50	1.68	1883	1
Do	169	3551	Amber and yellow	3.800	7.53	1.50	10.50	1.68	1884	2
Mediterranean White	173	2174	Yellow	4.182	9.69	2.17	11.20	1.79	1883	1
Do	173	3553	White	5.580	7.74	1.75	13.13	2.10	1884	2
French Imperial	175	2178	Amber	4.594	9.55	1.95	12.95	2.07	1883	1
Do	175	3554	Red	4.880	7.00	2.00	12.60	2.02	1884	2
Gold Premium	183	2184	Yellow	3.818	9.44	2.17	11.38	1.82	1883	1
Do	183	3560	Light red	4.120	6.80	1.95	14.00	2.24	1884	2
Hick's Prolific	184	2186	Amber	2.879	9.21	2.04	10.33	1.65	1883	1
Do	184	3561	Red	3.890	6.88	1.45	12.78	2.02	1884	2
Geiger	192	2188	Yellow	4.064	9.92	2.20	14.33	2.32	1883	1
Do	192	3563	Amber	4.240	6.23	2.00	13.13	2.10	1884	2
Hybrid No. 37	193	2158	Yellow	3.559	10.72	2.44	11.90	1.90	1883	1
Do	193	3564	Amber and yellow	3.850	6.08	2.05	12.20	1.96	1884	2

Among the varieties which were analyzed in 1884, and also previously, six have shown a tendency to continued degeneration in their percentages of nitrogen and size. The rest have shown signs of improvement or remained stationary. The changes, then, which have been observed from year to year must be attributed to season and not to

the soil, although continued cropping on one soil, even with fertilizers, appears from the experiments of Lawes and Gilbert to somewhat diminish the percentage of nitrogen. Another year's crop will furnish interesting data upon this subject, no doubt confirming the views of the experimenters just mentioned that season has a greater effect upon grain than any other condition.

Among these analyses are found samples of wheat which have the greatest weight per bushel and per hundred grains of any which have been examined. These extremes are not, however, coincident, as may be seen from the following figures:

Extremes among Colorado wheats of 1884.

		Highest.	Number.	Lowest.	Number.
Yield per acre	bushels	86⅔	3560	2½	3575
Weight per bushel	pounds	68.6	3576	62.2	3534
Weight per 100 grains	grams	6.200	3569	3.160	3526
Albuminoids	per cent	14.88	3559	9.45	3524

The weight per bushel is dependent on various causes. High weight is almost, if not always, an evidence of high quality, but not always of a large, plump, well-matured grain. The hard red spring wheat of the Northwest, which is small in size, and not well matured in the sense of having a plump berry, with its usual amount of starch, is very heavy in its weight per bushel, while the large full wheat of Oregon, which is very starchy, is light in weight.

The following data show the variation:

Weight per bushel, &c., of hard, soft, and immature wheats.

HARD RED SPRING WHEAT.

No.	State.	Weight per bushel.	Weight per 100 grains.	Yield.	Quality.	Albuminoids.
		Pounds.	*Grams.*	*Bush.*		*Per cent.*
1863	Dakota	65.3	3.312	25½	Good	14.53
1864	do	66.5	2.802	26⅔	No. 1	15.23
1865	do	66.2	3.368	27	do	17.33
1866	do	65.2	3.389	27¼	do	14.00
1867	do	65.2	2.921	36	do	14.35
1868	Minnesota	65.5	2.780	(?)	do	16.35
1869	Dakota	66.8	3.700	(?)	do	16.28
2109	Manitoba	67.1	3.465	(?)	do	13.48
2111	Dakota	63.4	3.074	(?)	do	18.03
1644	Minnesota	64.9	3.331	(?)	Frozen	13.65
2107	do	64.3	2.926	(?)	No. 1	13.83

SOFT WHITE OREGON WHEATS.

772	Oregon	57.2	4.253		Extra	8.58
773	do	59.8	5.144		do	8.05

IMPORTED SOFT WHEAT.

779		62.2	4.710		Extra	10.33

Weight per bushel, &c., of hard, soft, and immature wheat—Continued.

OTHER SOFT WHEATS.

No.	State.	Weight per bushel.	Weight per 100 grains.	Yield.	Quality.	Albuminoids.
		Pounds.	*Grams.*	*Bush.*		*Per cent.*
832	Pennsylvania	60.4	2.710	44	Ordinary	9.98
759	Missouri	62.7	3.860	.....	....do	11.19
1288	Pennsylvania	62.1	2.526	.....	....do	10.50
1293	Michigan	62.1	4.196	.....	....do	10.85
1355	Maryland	63.4	3.077	.....	....do	10.85
1356	North Carolina	66.2	3.653	.....	....do	10.55
1853	West Virginia	64.5	3.392	15	Good	11.30
2112	Virginia	65.0	3.569	20	....do	12.60

IMMATURE AND POOR WHEATS.

1804	Alabama	52.3	2.011	3.5	Poor	10.85
1805	....do	62.3	3.710	10.3	Fair	10.85
1806	....do	49.8	2.242	5.2	Bad	9.98
1809	....do	63.5	3.486	5.3	Fair	11.03
1812	....do	48.1	2.166	2.8	Bad	9.80
1813	....do	57.0	2.675	1.6	Poor	11.38

AVERAGE OF 42 POOR WHEATS FROM OHIO IN 1883.

2701-2742	.....	56.6	3.458	39.3	Shriveled	12.89

WHEATS WITH HIGHEST AND LOWEST ALBUMEN AND LARGEST SIZE.

2111	Dakota	63.4	3.074	.....	High albumen	18.03
1854	Washington Territory	63.5	2.584	.....	Low albumen	7.70
3536	Colorado	64.4	5.560	.....	.....	12.08

HIGHEST WEIGHT PER BUSHEL.

3570	Colorado	68.6	4.060	.....	Hard red	12.95

LOWEST WEIGHT PER BUSHEL.

1812	Alabama	48	2.166	.....	Immature	9.80

From these figures, which have been obtained by weighing miniature bushels which were graduated by comparison with the weight of large amounts of grain in struck bushels, it appears that hard spring wheat will average about 65½ pounds per bushel, soft white Oregon 58½ pounds, the ordinary soft wheat of the East 62.5, the poorly-matured grain of Alabama 55.5, the crop of 1883 in Ohio 56.6, while we have seen that the large plump Colorado grain weighs 65.2 pounds. The averages for different seasons in Colorado vary directly as the percentages of albuminoids, although among the less fully-matured grain the lighter often contains more nitrogen from lack of starch, as in the case of the Ohio crop of 1883. This was found to be the case by Lawes and Gilbert in their experiments, but does not always hold true, as may be seen among the Alabama wheats and some others. The Oregon wheats finely matured, rich in starch, and low in nitrogen, which are very spongy and light in weight, are illustrative of this point.

Conditions of growth and seed formation are so many and so varied that what may be true for one locality will often not apply to another which is far distant.

RELIABILITY OF SPECIMENS AND SAMPLING.

The question has been raised as to whether any specimen or sample of wheat would represent the average composition of a field or large crop, or of a large mass of wheat in elevator, for instance, and whether the analyses of the specimens which have been examined in this and previous reports could be relied on on this account.

An attempt has been made to solve this question, and with satisfactory results. In Bulletin No. 1 of this division analyses are given of two samples of wheat from the same lot of grain purchased by the Department as seed, the one selected in 1881 and the other in 1882, and analyzed without it being known to any one that they were intended to be identical. The results were closer than would probably be the case in most sampling.

Red Mediterranean wheat.

	1882.	1883.
	Per cent.	*Per cent.*
Water	9.83	9.88
Ash	1.70	1.62
Oil	2.21	2.06
Carbhydrates	73.73	73.80
Crude fiber	1.68	1.79
Albuminoids	10.85	10.85

To decide as to variations in composition in different parts of the same field and of the same farm, and of different varieties on the same farm and of differently developed heads and sized kernels of the same variety, personal selections were made from a wheat farm in Carroll County, Maryland, belonging to Mr. Alastair P. Gordon-Cumming.

The specimens may be described as follows, with a determination of albuminoids—a point which, it was believed, will settle any large variation in composition:

From a field of Fultz, bottom land, best quality.

Serial number.	Number of heads.	Length of head in inches.	Average weight in grams.	Number of grains of wheat.	Weight of grain in grams.	Per cent. of grain.	Weight per 100.	Per cent. of albumen.	Name.
2769	21	.....	0.80	325	14.67	79.3	4.517	9.80	Rakings.

From twenty-two average heads were selected:

2770[1]	1	4.0	.89	30	.535	.....	1.621	12.78	Longest, not well filled.
2770[2]	1	3.8	1.89	45	1.282	.....	2.085	11.81	Next longest, well filled.
2770[3]	8	3.5	1.46	285	9.055	.....	3.177	12.78	Long.
2770[4]	9	3.3	1.21	273	8.035	.....	2.943	12.78	Short.
2770[5]	3	3.0	1.04	73	2.260	.....	3.096	12.60	Shortest.

A patch of white Mediterranean seed from Department, second year's growth.

Serial No. 2768, 33 heads, weighing 37.5 grams and yielding 567 grains, or 75.2 per cent., weighing 28.197 grams, of which 461 were sound and 106 sprouted in the stack.

The sound weighed per 100, 4.875 grams; the sprouted, 5.400, and contained albuminoids; the sound, 12.08 per cent.; the sprouted, 13.48.

A field of Fultz, from a different portion of the same farm, gave among 14 average heads, weighing 391 grains:

Serial number.		Number of grains.	Weight.	Weight per 100.	Albuminoids.
2771[1]	Large plump grains	240	8.792	3.663	14.00
2771[2]	Smaller grains	150	4.085	2.723	11.88

Among the Fultz sports were found:

2772[1]	Bearded brown chaff			4.184	11.03
2772[2]	Smooth brown chaff			3.995	14.00

The results show that where the divisions have been made on marked characteristics there is a difference in composition; but that for averages from the same field, even where some physical differences could be noted, there is little variation on analysis. Three of six samples from a field of Fultz were exactly alike in their percentage of albuminoids, another was only .18 per cent. different, or practically the same, while the rakings from the field were, as might be expected, low in albuminoids. One selected head also fell below the average composition for some unexplained reason. In this field of Fultz, therefore, there seems to be sufficient evidence to give us confidence in our results.

The next samples were taken from a shock of wheat, and the grain was found on preparation for analysis to have sprouted. It was therefore divided into two parts. The grain which sprouted was the heavier and best developed and contained the most albuminoids. This is also the case in another field of Fultz on the same farm, where an average sample was divided into large and small grains, the larger having the most albuminoids. That this is not by any means always the case, however, it seems fair to believe from our experience with high relative proportion of nitrogen in specimens of shriveled wheat from other parts of the country. These kernels were none of them shrivelled; on the contrary, plump, and that some were merely more vigorous than others must stand as an explanation.

Sports or stragglers in the same field of Fultz were found to vary very largely from each other and a little more than the different-sized grains of Fultz. This must be attributed to peculiarities in the variety and their different ability to assimilate nitrogen under the circumstances.

These remarks must be regarded as suggestions only, as any absolute interpretation of the results is impossible. They serve, however, to show the constancy of the average composition of an average head, and of the average of the crop.

CHARACTERISTICS OF THE WHEAT GRAIN.

From observations in this and previous reports it may be said that of all grain wheat is probably the most susceptible to its environment.

Oats in certain directions are more variable, but in their general characteristics are much more permanent, as will appear in subsequent pages. The inherent tendency to change which is found in all grains is most prominent in wheat. It may be fostered by selection and by modifying such of the conditions of environment as it is in the power of man to affect.

The most powerful element to contend with is the character of the season or unfavorable climatic conditions. The injury done in this way is well illustrated in Colorado; and it would seem advisable in such cases to seek seed from a source where everything had been favorable, and begin selection again.

It must be borne in mind that selection must be kept up continuously, and that reversion takes place more easily than improvement. It took but one season to seriously injure Professor Blount's wheats, but it will be two or more years before they have recovered from that injury. Hallett in England was able to make his celebrated pedigree wheat by selection, carried on through many years, but the same wheat grown by the ordinary farmer under unfavorable conditions for a few years without care has reverted to an ordinary sort of grain.

The effect of climate is well illustrated by four specimens of wheat which are to be seen in the collection of the chemical division. Two of these were from Oregon and Dakota some years ago, and present the most extreme contrast which can be found in this variable grain. One is light yellow, plump, and starchy, and shows on analysis a very small proportion of albuminoids; the other is one of the small, hard, and dark-colored spring wheats of Dakota, which are rich in albuminoids. Between these stand two specimens from Colorado, which have been raised from seed similar to the Oregon and Dakota wheat. They are scarcely distinguishable except by a slight difference in color. The Colorado climate is such as to have modified these two seed wheats, until after a few years' growth they are hardly distinguishable in the kernel.

All localities having widely different climates, soils, or other conditions produce their peculiar varieties and modify those which are brought to them.

The result of these tendencies to change and reversion from lack of care in seed selection or other case has led to the practice of change of seed among farmers. A source is sought where either through greater care or more favorable conditions the variety desired has been able to

hold its own. Sometimes this change is rendered necessary by conditions which are beyond the power of man to modify. As an example, No. 10 of Professor Blount's wheats, known as "Oregon Club," a white variety from Oregon, has been deteriorating every year since it has been grown in Colorado, whereas if the seed had been supplied every season directly from Oregon the quality would probably have remained the same. In extension of this illustration, the fact may be mentioned that annual renewal of the seed from a desirable and favorable source often makes it, possible to raise cereals where otherwise the climatic conditions would render their cultivation impossible through rapid reversion. This is particularly the case with extremes in latitude, the effect of which is found not so much upon the composition of the crop as on the yield and size of the grain. In the South the warmer climate, together, of course, with poorer soil and cultivation in many instances, reduces the yield. The average in different States is given by Mr. Dodge as follows:

Yield per acre of wheat.

State.	Per cent.	State.	Per cent.	State.	Per cent.
Maine	15.2	South Carolina	5.6	Michigan	19.5
New Hampshire	15.0	Georgia	6.6	Indiana	18.0
Vermont	16.3	Florida	5.2	Illinois	15.9
Massachusetts	16.4	Alabama	5.7	Wisconsin	12.8
Rhode Island	14.1	Mississippi	5.0	Minnesota	11.4
Connecticut	17.6	Nevada	16.8	Iowa	10.2
New York	15.7	Louisiana	3.4	Missouri	12.0
New Jersey	12.7	Texas	6.8	Kansas	9.3
Pennsylvania	13.5	Arkansas	6.2	Nebraska	9.4
Delaware	13.4	Tennessee	6.1	California	22.0
Maryland	14.1	West Virginia	10.2	Oregon	15.8
Virginia	8.7	Kentucky	9.8	Colorado	18.9
North Carolina	5.2	Ohio	18.0		

It must be remembered, however, that three quarters of the wheat crop has been produced in the ten States of Illinois, Indiana, Ohio, Michigan, Minnesota, Iowa, California, Missouri, Wisconsin, and Pennsylvania, and that a State like Minnesota must not be considered as furnishing the largest part of the supply merely because wheat is the prevailing crop in that State.

Having shown the conditions under which unfavorable and favorable variations occur, it is hoped that these investigations will be the means of aiding those who are engaged in the improvement of the yield and quality of the crop of our country.

It seems proper in this place to allude also to the immense amount of the best food elements of our soils which are yearly being taken from the farm and exported from our ports in the shape of nitrogen and the mineral constituents of the grain, the loss of which is continually rendering our wheat lands poorer and forcing the cultivation into new parts of the country where the soil is still of virgin richness. If grain is sold off the farm the loss of nitrogen and minerals must be replaced

by fertilizers. In the East this is already done, but in the West it seems that nothing but experience of wasting fertility will teach the lesson.

OATS.

Oats, the third in importance of our cereal crops, as far as production is concerned, are grown under as varied conditions as any of them and are as a crop the most variable in their appearance.

They will grow and can be made to pay on almost any soil, and, although flourishing in cold climates, can be successfully raised in the far South by sowing as a winter grain and so reaching maturity in the cool part of the year.

In consequence of these variations in the conditions of growth there are to be found the greatest differences in weight and size of the grain, its plumpness, and the relative proportion of kernel and husk. Dependent on these differences many classifications have been proposed, but as there seems to be a regular gradation from the one extreme of the white potato oats to the other of red rust proof, there seems to be no definite basis for varieties due to color, shape of the grain, or plumpness. Botanically, there seem to be three varieties recognized—the common *Avena sativa* L., and two others, *A. orientalis* Schb., having the kernels all on one side of the stem, and *A. nuda* L., to the grain of which the husks or chaff are not adherent.

For our consideration, from a chemical and physical point of view, these distinctions are of small importance, as the same variations are found among each species.

To the farmer the most important characteristic, and the one by which this grain is usually valued, is its weight per bushel. In close relation to this is the proportion of kernel to husk—a point which has been little, if at all, investigated. In the specimens which have been collected from the most prominent regions where oats are grown these characteristics have been determined, as well as the size and weight of the kernels, with the purpose of studying not only the way in which they are affected by surrounding causes, but also their relation to the composition of the grain.

The sources of the specimens examined, their color and shape, and other physical characteristics are here presented.

Sources of specimens of oats.

State.	Serial No.	Name.	Sown.	Harvested.	County.	Post-office.	Sender.	Remarks.
Alabama	3001	Red Rust Proof	Sept. 15 to Nov. 15	June	Lawrence	Wheeler	J. J. Barclay	
	2002	do	Aug. to Feb	June	Talladega	Talladega	H. M. Burt	
	3003	do	Oct. to Jan	May to June	Barbour	Hawkinsville	H. Hawkins	
	3007	Brewington Rust Proof	November	June 10	Lee	Salem	G. L. Webster	
	3008	Imp. Red Rust Proof	Sept. to Dec Jan. to Mar	May 20	Dallas	Selma	Joseph Hardie	
	3012	Red Rust Proof	Fall or Spring	May to June	Hempstead	Washington	A. H. Carrigan	
California	3016	White Oats	Feb. to Mar	End of July	Contra Costa	Martinez	J. Strentzel	"Feeding" from warehouse.
Colorado	3020	Welcome	May 10	Aug. 14	Douglas	Castle Rock	L. W. Wells	
	3021	Russian White fr. Dept	Mar. 1 to Apr. 15	July 10 to 20	Custer	Wetmore	J. W. Coleman	
Connecticut	3024	Common White	Spring	July 15 to 30	New Haven	South Britain	W. L. Mitchell	
	3027	do	Apr. 21	Aug. 1	New London	Groton	J. J. Capp	Raised in Conn. a long time.
	3028	do	May 1	Aug. 14	Litchfield	West Cornwall	T. S. Gold	
	3029	White Russian or Commoo.	Apr. 10 to May 1	July 25 to Aug. 10	Fairfield	Green Farms	W. J. Jenninge	
Dakota	3030	Wisconsin White	May 24	Sept. 1	Stutsman	Jamestown	J. J. Nichols	
	3031	(?)	March, early	Last of July	Turner	Swan Lake	S. Frye Andrews	
	3034	Common White	Apr. 19	Aug. 1	Lincoln	Worthing	C. Cungdon	
	3035	White Russian	May 15	Aug. 15	Cass	Fargo	W. H. Leverett	
	3036	White Australian	Apr. 1	July 15	Bon Homme	Tyndall	A. Zenert	Seed years ago from Department, 1881.
Delaware	3038	Common White	Mar. 22	July 18	New Castle	Red Lion	Samuel Silver	
Florida	3041	Red Rust Proof	December	April to May	Sumter	Yallaha	J. W. Le Felmster	
	3042	Rust Proof	December	May	Columbia	Mikesville	J. R. Liter	
	3043	Major Briton	Dec. 15 to Jan. 15	May	Jackson	Sneads	Pat Ham	
	3044	Horn Rust Proof	December	June 1	Tallahassee	Leon	Jno Bradford	
	3045	Texas Rust Proof	Jan. 1 to 10	June 6	Madison	Greenville	M. W. Linton	
Georgia	3047	North Carolina	February	June 15	Bartow	Cartersville	C. H. Smith	
	3049	Huroicutt	July to Oct	June 1 to July 15	Wilkes	Washington	J. T. Wingfield	From Department several years ago, 1877 or 1878.
	3049 II	Rust Proof	July to Oct	June 1 to July 15	Wilkes	Washington	J. T. Wingfield	Do.
	3049 III	Virginia	July to Oct	June 1 to July 15	Wilkes	Washington	J. T. Wingfield	Do.
	3049 IV	Tennessee	July to Oct	June 1 to July 15	Wilkes	Washington	J. T. Wingfield	Do.
	3050	Rust Proof or Horn Oat	Oct. 1 to Mar. 10		Thomas	Cairo	E. F. Richter	
	3052	Red Rust Proof	Oct. 1 to Feb. 1	June 1	Brooks	Quitman	J. G. McCall	
Illinois	3055	Common Black	Mar. to Apr	July	Madison	Highland	J. Balsiger	
	3057		do	July 15	Clinton	Carlisle	O. B. Nichols	
	3060		Apr	July to Aug	Will	Crete	J. O. Piepenbriok	
	3062	Schünen	Apr. 10 to May 1	July 25 to Aug. 10	Stephenson	Howardsville	A. M. Durkee	Seed from Department.
	3063	Common White	Apr	Aug. 1	Ogle	Baileyville	W. B. Derrick	
	3065	White Russian	Early Apr	do	McHenry	Crystal Lake	F. Cole	70 bushels per acre.
	3066	Black	Apr. 15	July 20	Livingston	Cayuga	E. W. Pearson	
	3067	Common Mixed	Early spring	July 15 to 20	Lee	Dixon	Abram Brown	

	3068	Norway and a little White.	Apr. 3	July 25	La Salle	Tonica	L. A. Burgess	
	3070	Early White Tobin	Apr. 1 to 10	July 15	Kankakee	Momence	A. L. Miner	
	3075	Black	Apr. 15	July 18	Du Page	Downer's Grove	H. L. Bush	
	3078	Barley	Apr. 10	July 25	Champaign	Homer	W. A. Conkey	36 to 40 pounds to bushel.
	3079	Common White	Apr. 1	do	Bureau	Princeton	D. Knight	
Indiana	3084	Russian White	Apr. 14	July 15	Lawrence	Erie	Mortimer Grabb	
	3085	Northern	Feb. to Apr. 1	July 1	Spencer	Rockpor	James Lane	
	3086	Common	Apr. 20	Aug. 1	Elkhart	Goshen	P. F. Nye	
	3089	Common White.	Mar. 1 to 25		Benton	Chase	J. M. Stanley	60 to 90 bushels per acre
Iowa	3094	Common	Mar. 20 to Apr. 15	July 15	Taylor	Conway	J. L. Heer	
	3097	German	Mar. 25 to Apr. 10	July 25 to Aug. 5	Sac	Wall Lake	J. H. Hoebing	Raised for 5 to 6 years.
	3098	White Russian	Apr. 10 to 15		Palo Alto	Ruthven	J. A. Anthony	
	3101	do	May 1	Aug. 1	Winneshiek	Decorah	M. H. Merrill	
	3104	Schänen	Apr	July 25	Fayette	West Union	B. F. Conkey	
	3107	Norway Spring	do	Aug. 1	Clinton	Bryant	Dan. Conrad	
Kansas	3113				McPherson	Galvo	J. Richey	
Kentucky	3116	Norway	Mar. 15 to 30	June 1	Lawrence	Louisa	J. M. Clayton, jr.	
	3117	Black	Feb. to Mar	July 15	Morgan	West Liberty	W. W. Cox	
	3119	Red	do	June	Washington	Willisburgh	J. B. Lilzey	
	3122	Michigan White	Mar. 20	July 10	Jefferson	Fern Creek	Noah Cartwright	
Louisiana	3126	Rust Proof	Oct. 1	June	Bienville	Mount Lebanon	W. B. Culbert	
	3127	Red Rust Proof	Oct. 1 to 15	May 15 to 30	Claiborne	Homer	A. T. Nelson	
Maine	3131	Common Bush	May 1	Aug. 1	Waldo	Unity	B. B. Stevens	
	3133	English	May 16	Aug. 19	Kennebec	North Belgrade	A. E. Faught	Imported in 1880.
	3134	White Canada	May 20	Aug. 20	Cumberland	Harrison	A. Moulton	
Maryland	3140		Mar. last	June 25 to July 30	Frederick	Frederick	H. C. Brown	
	3141	White Russian	Apr. to May	Sept. 1	Garrett	Oakland	P. Hamill	Fair average.
Michigan	3151	do	Apr. 20	Aug, 1st week	Genesee	Flint	F. H. Raokin	
	3153	do	Apr. 21	Aug. 20	Livingston	Hartland	I. D. Crouse	
	3156		Apr. 26	Aug. 15	Ottawa	Berlin	C. W. Wilde	
	3158	Early Probsteer	Apr. 24	Aug. 5	Saint Clair	Jeddo	Moses Locke	
	3160	Michigan White	Apr. 25 to May 10	July 25 to Aug. 1	Shiawassee	Corunna	S. R. Kelsey	
Minnesota	3163	White Russian	Apr. 17	Aug. 12	Todd	Long Prairie	L. S. Hoadley	
	3166	Fine Fellows	May, middle	Aug. 22	Otter Tail	Deer Creek	C. F. Mason	As from thrasher.
	3168	Common White	May 8	Aug. 20	Anoka	Anoka	A. Small	
	3169	White Dutch	Apr. 10	Aug. 1	Dodge	Mantorville	C. W. Cushing	
	3170	Common White			Winona	Minnesota City	O. M. Lord	
	3172	White Russian	Apr. 10	Aug. 1	Dakota	Hastings	R. A. Simmons	
	3175	Minn. White and Black	Apr. 15	do	Blue Earth	Willow Creek	E. F. Wilder	
	3176	White German	Apr. 26	do	Olmsted	Marion	A. J. Goode	
	3179	Common White	May 7	Aug. 5	Fillmore	Fillmore	G. W. Knight	
Mississippi	3180	(?)			Calhoun	Pittsborough	L. W. Harrelson	
	3181	Red	Sept. 15 to Feb. 15	May 15 to June 15	Choctaw	Chester	R. H. Biggers	
	3182	Red Rust-Proof	Oct. to March	June 1	Copiah	Hazlehurst	W. J. Rea	
	3183	do	Feb. 15	June 15	De Soto	Poplar Top	E. R. Hart	
	3184	do	Oct		Covington	Station Creek	C. Welch	
	3185	do	Nov. 15	May to June	Hinds	Raymond	W. J. Crisler	
	3187	do	Jan. 15	June 15	Noxubee	Macon	M. Mahorner	
Missouri	3188	Irish White	Apr. 1 to 20	July 15 to 25	Atchison	Langdon	R Buckham	
	3190	Black	Mar., 1st week	July, 2d week	Johnson	Fayetteville	W. B. Ames	
	3191	White	Apr.	Aug	Putnam		Merritt Young	

Sources of specimens of oats—Continued.

State.	Serial No.	Name.	Sown.	Harvested.	County.	Post-office.	Sender.	Remarks.
Montana	3196	Minnesota	Apr. 1	Sept. 1	Meagher	Canton	J. G. Pickering	
	3197	Common White	May 5	....do	Gallatin	Bozeman	W. Flannery	
Nebraska	3198	Yellow Russian	Apr. 1	July 10	Antelope	Neligh	F. H. Trowbridge	
	3200	Black and white	Apr., 1st week	Aug. 10	Lancaster	Waverly	W. F. Truell	
Nevada	3205	Poland	Apr. 1	Oct	Douglas	Genoa	H. F. Dangberg	
NewHampshire	3208	Native	Apr. to May	Aug	Sullivan	Newport	J. M. Wilmarth	
	3209	Russian	May to June	Aug. to Sept	Coos	Hazen's Mill	L. T. Hazen	35 pounds per bushel, usually 45; from Centen.
	3210	Common White	May 15 to 25	Aug. 1 to 15	Grafton		Francis Potter	
New Jersey	3214	Branch White	Apr. 1	July 20 to 25	Somerset	Blawenburgh	D. C. Voorhees	
	3215	Jersey	Early spring	Aug. 1	Morris	Morristown	J. R. Runyon	
New Mexico	3218	White and Black	Apr. 20 to May 10	Aug. 20, about	San Miguel	Gallinas Spring	J. E. Whitmore	
New York	3226	Common White	May 8	Aug. 24	Allegany	Nile	J. D. Rogers	47 bushels per acre cut green; seed from the West.
	3228	Western	May 15	Aug. 25	Cattaraugus	Little Valley	J. S. Huntley	
	3230	Common White	Apr. 24	Aug. 8	Delaware	Sidney Plains	I. F. Shermao	
	3231	Native	Apr. 20	Aug. 1	Dutchess	Mount Ross	B. Wilbur	
	3232	Probsteier	May 1 to 15	July 10 to 20	Ontario	Naples	J. M. Anable	
	3233	Marrowfat	Apr. 25	Aug. 1	Otsego	Cooperstown	G. P. Keese	
	5234	Common	Apr. 15 to May 1	Aug. 20 to Sept. 10	Saratoga	Greenfield Centre	B. S. Robinson	
	3235	(?)	Apr. 15	Aug. 1	Schoharie	Schoharie	I. C. Van Tuyl	
	3240				Onedia	Veruona	George Benedict	
	3243	Mold Ennobled	Apr. 15	Aug. 20	Cayuga	Fleming	H. Tryan	Department, 1880.
North Carolina	3249	Black Prolific	Mar. to Apr	Aug	Alleghany	Elk Creek	I. W. Landreth	
	3251	Rust Proof	Nov. or Feb	May or June	Bertie	Windsor	J. B. Martin	
	3253	Red Rust Proof	Sept. 10	June 25	Guilford	New Garden	J. S. Hodgin	
	3255	Early Rust Proof	Aug. to Sept	May 15	Union	Monroe	H. M. Houston	
	3256	Winter	Sept	June	Rockingham	Ruffin	T. L. Rawley	
	3257	Red Rust Proof	....do	July	Rowan	Salisbury	J. L. Hedrick	
Ohio	3260	Spranly	Apr. 1 to 15	July 5 to 15	Butler	Gano	Joseph Allen	
	3261	(?)	Apr. 1	Aug. 1	Fulton	Wauseon	J. D. Aldrich	
	3262	Welcome	Apr. 11 to May 1	July 20 to Aug. 10	Holmes	Black Creek	W. H. Hall	
	3267	Yellow Ohio	Apr. 1	July 15 to 30	Richland	Mansfield	O. F. Stewart	
	3268	White German	Apr. 15	July 24	Seneca	Tiffin	John Seitz	
	3269	Common White	Apr. 10	July 19	Wood	Mermill	Andrew Welton	
	3270	.....do	Mar. to Apr	Aug. 1	Williams	Bryon	S. B. McKelvy	
	3271	.....do			Warren	Lebanon	D. P. Egbert	
	3272	Schauen	Apr. 15	July 15	Wayne	Apple Creek	L. C. Reichenbach	
Oregon	3275	White Russian	Apr. 1	Sept. 1	Baker	Baker City	T. Smith	
	3277	Hopkin	Feb. to May	July to Aug	Linn	Albany	G. F. Crawford	
Pennsylvania	3282	Mixed	Mar. to Apr	Aug	Union	Lewisburg	J. A. Gundy	
	3285	White Russian	May 11	Aug. 1	Crawford	Conneautville	R. Bolard	

	3286	Department Seed	Early spring	do	Butler	Butler	H. I. Berg	
	3286a	Common	do	do	do	do	do	
South Carolina.	3294	Rust Proof	Nov. 10	June 1	Marlborough	Bennettsville	J. H. Parham	
	3295	Red Rust Proof	Nov	May	Charleston	Charleston	G. S. Holmes	
	3296	do	Aug	June	York	Rock Hill	I. Jones	
	3297	do	Sept. to Mar	May to June	Orangeburg	Orangeburg	A. M. Salley	
	3298	do	Sept. 1 to Mar. 1	June 1	Lexington	Lexington	S. Corley	
	3299	do	Sept	June	Laurens	Goodgion's Factory	J. S. Wolff	Injured by wet weather
	3300	do	Sept. 15 to Nov. 1, and Jan. 15 to Feb. 15.*	May 10 to 20	Barnwell	Martin	J. C. Brown	
	3301	do	July 20 to Oct. 30, and until Feb. 1.	June 10 to 20	Abbeville	Abbeville	J. F. C. Du Pre	Wet.
Tennessee	3302	(?)	Mar. 10	July 1	Wilson	Watertown	W. L. Waters	Late sown.
	3303	Winter	Aug. and Sept. and at other times.	June and later	Washington	Crookshanks	J. A. Jones	
	3304	Rust Proof	Feb. 15 to Apr. 1	June 20 to July 10	Roane	Kingston	J. R. Martin	
	3309	Gaines Winter	Sept. 15	July 1	Bedford	Rover	B. F. Jarrett	
Texas	3310	White Cluster	Nov. 1	May 15	Anderson	Montalba	W. J. Hamleth, sr.	
	3311	Georgia Red Rust Proof.	Oct. 1 to Feb. 1	May 20 to June 10	Travis	Austin	W. H. D. Carrington.	
	3313	Red Rust Proof	Oct. to Mar	May 20 to July 1	Hill	Hillsborough	W. B. Turner	
	3314	do	Feb	June 1 to 15	Denton	Denton	J. W. Kenady	
	3315	Southern Rust Proof	Jan. to Feb	do	Collin	Beth	W. G. Matthews	
	3316	Red Rust Proof	Oct. to Mar	May 1 to June 1	Bell		H. J. Chamberlain	
	3317	do	do	May to June	Dallas	Dallas	J. B. Simpson	Average.
Utah	3319	White Somerset	May 10	Sept. 10	Wasatch	Heber	T. Crook	
	3321	(?)	Apr. 1	Aug	Sevier	Richfield	William Morrison	
Vermont	3322	Common White			Bennington	Manchester	G. G. Burton	
	3323	White Schönen	May 5		Windsor	Pomfret	Crosby Miller	
	3324	White Probsteier	May 1 to June 20	Aug. 10 to Sept. 20	Washington	Montpelier	A. D. Arms	
	3326	White Australian	May 5	Aug. 18	Orleans	Irasburg	Z. E. Jameson	Fourth growth from Department seed.
Virginia	3329				Loudon	Farmwell	Van Quick	
	3331	Winter	Aug. 15 to Nov. 15	June 10	Mecklenburg	Clarksville	J. R. Leigh	
	3334	Welcome	Mar. 1 to 25	End of July	Floyd	Floyd C. H	Benjamin Phlegar	
	3335	Winter	Sept. 1 to 20	June 20 to 30	Bedford	Morch	J. E. Lazenby	
	3337	Centennial	Mar	July	Amherst	Harris Creek	M. H. Gorland	
Washington	3341	Common White	Apr. 1 to 20	Aug. to Sept	Skagit	Lyman	Lyman Everett	
West Virginia.	3345	Common White	April 7	July 14	Wayne	Ceredo	Z. D. Randell	
	3346	Canada White	Apr. 15 to May 1	July 25 to Aug. 1	Ohio	Roney's Point	T. J. Orr	
	3347	White Russian	Apr. 1	July 15	Fayette	Clifty	A. K. McCutcheon	
	3348	Canada White	March to April	July 15 to Aug. 10	Greenbrier	Lewisburg	H. Handley	Two years here.
Wis	3351	White Surprise	Apr. 26	July 30	Chippewa	Eagle Point	John Bates	
	3356	(?)			Rock	Evansville	W. R. Phillips	
	3357	German	Apr. 15	Aug. 10	La Fayette	Fayette	S. E. Roberts	
	3360	White German	Apr. 15	Aug. 20	Fon du Lac	Metomen	E. Reynolds	
	3361	White Somerset	Apr. 25 to 30	Aug. 1	Dodge	Burnett	Hiram Lawyer	

Sources of specimens of oats—Continued.

SUPPLEMENTARY LIST.

State.	Serial No.	Name.	Sown.	Harvested.	County.	Post-office.	Sender.	Remarks.
Alabama	3363	Rust Proof	Fall or spring	June 1 to 10	Pickens	Carrollton	S. H. Hill	Average.
Arkansas	3366	Red Rust Proof	November	May	Lee	Marianna	J. M. Daggett	
	3368	Arkansas Red			White	Searcy	R. J. Rogers	
California	3374	(?)	January		Solano		G. S. Myers	
	3378	Egyptian	Jan., Feb., Mar		Monterey	Salinas	J. R. Leese	
	3380	Common White	Dec. to Apr. 1	May to June	Sonoma	Santa Rosa	E. W. Davis	
	3382	Fielder	Feb. 15	End of August	Humboldt	Eureka	Fred Axe	
Colorado	3384	White Belgian	May 28	do	Saguache	Saguache	Owen Malone	
	3385	White Russian	Apr. 15	Aug. 15	Pueblo	Pueblo	I. W. Stanton	
	3386				La Plata	Parrott	(?)	
Dakota	3390	Russian			Trail	Caledonia	P. Herbrandson	
	3391	White	May	Second crop	Lawrence	Deadwood	J. Carney	
Florida	3392	Early Egyptian	Dec. to Feb. 15	Apr. 15 to May 20	Jefferson	Monticello	D. H. Bryan	
Georgia	3395	Rust Proof	Jan. 15	Apr. 15 to May 1	Houston	Perry	G. W. Killon	
Iowa	3445				Lyon	Larchwood	J. B. Warren	
Louisiana	3441	Red Rust Proof	Oct. 15 to Feb. 15	May 15 to June 15	Lincoln	Vienna	E. M. Graham	
Michigan	3406	Common White	May 20	Sept. 1	Cheboygan	Cheboygan	Jacob Walton	
Minnesota	3407	Yellow German	Apr. 13	July 17	Wabasha	Wabasha	H. I. Whitmore	
Missouri	3411	Yellow			Cedar	Stockton	J. A. Barrou	
Montana	3415	White Russian	May 10 to 20	Sept. 1	Deer Lodge	Deer Lodge City	D. C. Irvine	
New Mexico	3420	White	March late	Sept	Taos	Feroandez de Taos	W. L. McClure	
Ohio	3444		Mar. 1	June to July	Butler	Hamilton	G. H. Shaffer	
South Carolina	3429	Red Rust Proof	Aug. to Sept	Early June	Edgefield	Edgefield C. H	E. L. Geerard	
Texas	3430	do	Spring or fall		Hill	Hillsborough	J. W. Perry	
Washington	3435	Gray Winter	Early spring	Late Sept	Pierce	Tacoma	L. E. Sampson	

Physical properties of oats.

State.	Serial number.	Weight of 100 grains.	Clean grain.	Hulled grain.	Hulls.	Weight per bushel.	Color.
		Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Lbs.*	
Maine	3131	2.144	96.02	69.54	30.46	34.7	Light.
Do	3133	2.610	98.22	69.65	30.35	44.2	White.
Do	3134	2.279	97.89	71.68	28.32	36.8	Light.
New Hampshire	3208	2.060	98.04	.....	.....	33.5	Yellow and green.
Do	3209	2.890	85.34	70.88	29.12	40.7	Yellow.
Do	3210	2.465	98.10	72.20	27.80	40.7	Light.
Vermont	3322	2.324	97.27	71.01	28.99	40.2	White.
Do	3323	2.122	93.74	70.98	29.02	36.9	Light.
Do	3324	2.695	93.65	71.39	28.61	37.3	Do.
Do	3326	2.756	95.22	64.72	35.28	43.1	Do.
Connecticut	3024	1.796	97.09	69.25	30.75	37.7	Yellow and green.
Do	3027	1.935	91.90	65.70	34.30	29.5	Light.
Do	3028	2.128	97.97	72.18	27.82	37.6	White.
Do	3029	2.580	96.15	62.63	37.37	37.6	Light brown.
Total		8.439	383.11	269.76	130.24	142.4	
Average		2.810	95.78	67.44	32.56	35.6	
New York	3226	2.342	98.70	66.70	33.30	39.0	Light.
Do	3228	2.663	92.57	73.83	26.17	40.1	Mixed.
Do	3230	.....	.....	.....	.....	38.0	Light.
Do	3231	2.192	95.80	68.20	31.80	35.2	Do.
Do	3232	2.856	96.10	73.50	26.50	42.9	Do.
Do	3233	3.127	98.17	71.49	28.51	41.8	Do.
Do	3234	2.029	99.14	70.82	29.18	37.3	White.
Do	3235	2.921	86.30	73.24	26.76	44.1	Brown.
Do	3243	2.430	95.81	70.20	29.80	41.9	Do.
New Jersey	3214	2.709	98.80	75.10	24.90	41.4	White.
Do	3215	2.033	98.20	70.40	29.60	31.7	Light.
Pennsylvania	3282	2.207	96.44	69.65	30.35	32.5	Do.
Do	3285	2.617	96.94	69.04	30.96	38.1	Do.
Do	3286	3.010	94.15	71.34	28.66	43.7	White.
Do	3286[1]	2.910	81.44	64.18	35.82	37.8	Light.
Ohio	3260	2.248	99.30	73.33	26.67	39.9	White.
Do	3261	2.130	87.74	74.95	25.05	41.0	Light.
Do	3262	2.670	96.84	60.83	39.17	40.0	Do.
Do	3267	2.722	95.31	72.07	27.93	39.9	Do.
Do	3268	2.224	98.30	74.62	25.38	40.0	Do.
Do	3269	2.010	95.56	69.08	30.92	37.8	Yellow and green.
Do	3270	2.260	99.21	73.54	26.46	40.1	Light.
Do	3271	2.012	99.15	73.31	26.69	.....	
Do	3444	2.025	96.36	71.25	28.75	.....	
Michigan	3151	2.450	98.59	74.30	25.70	41.1	Light.
Do	3153	2.400	96.25	72.16	27.84	43.6	White.
Do	3156	2.864	97.58	72.41	27.59	42.8	Light.
Do	3158	2.904	97.09	70.91	29.09	43.7	White.
Do	3160	2.507	93.58	72.47	27.53	39.4	Light.
Do	3406	3.237	94.25	71.62	28.38	43.2	White.
Indiana	3084	2.414	99.65	70.69	29.31	35.3	Do.
Do	3086	2.086	82.73	73.40	26.60	39.4	Light.
Do	3089	2.060	97.71	71.92	28.08	35.4	Do.
Illinois	3055	.....	96.37	74.75	25.25	40.7	Mixed.
Do	3060	2.370	.....	66.58	33.42	41.5	White.
Do	3062	2.030	99.52	69.53	30.47	36.2	Light.
Do	3063	1.980	97.89	72.74	27.26	37.1	Light brown.
Do	3065	2.517	98.27	70.97	29.03	38.6	Light.
Do	3066	2.512	93.30	75.85	24.15	40.5	Brown.
Do	3067	2.014	98.35	70.46	29.54	38.8	Mixed.
Do	3068	3.025	98.93	74.97	25.03	41.5	Do.
Do	3068[2]	.....	95.09	72.32	27.68	.....	
Wisconsin	3357	2.920	95.24	70.53	29.47	43.7	Light.
Do	3353	2.450	96.53	68.99	31.01	39.7	Mixed.
Do	3357	2.377	97.10	70.03	29.97	38.9	White.
Do	3360	2.580	89.63	73.25	26.75	35.6	Do.
Do	3361	2.109	95.55	71.05	28.95	37.1	Do.
Minnesota	3166	2.180	97.84	69.27	30.73	35.4	Light brown.
Do	3168	2.038	98.10	73.50	26.50	42.0	White.
Do	3169	2.678	99.39	69.88	30.12	40.2	Do.
Do	3170	2.170	93.46	73.00	27.00	38.3	Light.
Do	3172	2.770	.....	72.62	27.38	48.4	White.
Do	3175	2.066	91.80	72.40	27.60	39.8	Mixed.
Do	3175[2]	2.075	93.72	72.91	27.09	38.1	Do.
Do	3176	2.610	98.14	69.60	30.40	40.5	White.
Do	3179	2.162	96.10	71.90	28.10	39.6	Light.
Iowa	3094	1.924	97.53	67.31	32.69	33.5	Do.
Do	3097	2.402	96.55	73.43	26.57	40.6	White.
Do	3098	2.253	97.07	74.78	25.22	.....	
Do	3101	2.413	95.94	71.87	28.13	42.1	Mixed.
Do	3104	2.172	97.16	70.07	29.93	38.9	Light.
Do	3107	2.308	97.67	72.34	27.66	37.1	Brown.

Physical properties of oats—Continued.

State.	Serial number.	Weight of 100 grains.	Clean grain.	Hulled grain.	Hulls.	Weight per bushel.	Color.
		Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds.*	
Missouri	3190	2.016	97.84	71.45	28.55	36.7	Mixed.
Do	3191	1.630	97.70	68.60	31.40	.....	
Do	3411	1.956	98.85	69.28	30.72	38.8	Yellow.
Nebraska	3198	2.194	99.00	73.20	26.80	39.5	Do.
Do	3200	1.582	97.20	68.30	31.70	30.2	Mixed.
Do	3200[1]	1.512	97.40	68.79	31.21	29.7	Do.
Dakota	3030	2.057	96.43	67.90	32.10	40.2	White.
Do	3035	2.367	92.04	72.39	27.61	44.7	Yellow.
Do	3036	2.957	96.12	62.20	37.80	48.6	Light.
Do	3390	2.844	92.33	73.16	26.84	44.3	Do.
Do	3391	2.372	87.70	55.37	44.63	38.8	White.
Montana	3196	2.528	94.49	70.10	29.90	45.0	White and brown
Do	3197	2.010	90.16	69.15	30.85	45.4	White.
Do	3415	2.691	88.54	72.36	27.64	39.5	Yellow.
Maryland	3140	1.850	94.86	71.70	28.30	35.0	Light.
Do	3141	2.637	91.65	71.36	28.64	40.9	Do.
Delaware	3038	1.976	98.04	69.59	30.41	.....	
Virginia	3331	2.720	93.00	72.40	27.60	39.0	Brown.
Do	3334	2.771	96.92	59.00	41.00	41.4	White.
Do	3335	2.480	94.09	64.29	35.71	35.5	Light.
Do	3337	.....	.....	.....	.....	40.8	White.
West Virginia	3345	1.872	97.19	71.26	28.74	37.4	Do.
Do	3346	3.386	96.55	67.59	32.41	38.3	Light.
Do	3347	1.969	93.55	64.48	35.52	38.5	Do.
Do	3348	2.773	96.45	62.60	37.40	36.4	Light brown.
North Carolina	3249	2.060	93.94	70.50	29.50	47.8	Brown.
Do	3251	1.834	97.10	70.30	29.70	36.4	Mixed.
Do	3253	3.362	94.30	68.70	31.30	37.2	Brown.
Do	3255	2.470	88.84	70.44	29.56	39.5	Black.
Do	3256	2.314	96.20	73.34	26.66	41.1	Light brown.
Do	3257	2.935	96.77	68.95	31.05	36.6	Brown.
South Carolina	3295	3.039	98.51	69.95	30.05	39.5	Do.
Do	3296	2.823	93.76	67.24	32.76	38.5	Do.
Do	3297	2.055	96.22	68.65	31.35	35.7	Light brown.
Do	3298	2.052	96.90	68.72	31.28	35.9	Yellow.
Do	3299	2.831	94.01	68.48	31.52	.....	
Do	3300	3.176	97.59	71.20	28.80	41.5	Brown.
Do	3301	2.981	93.78	73.33	26.67	37.8	Light brown.
Do	3429	3.179	97.17	68.61	31.39	39.8	Brown.
Kentucky	3116	2.279	98.52	72.70	27.30	.....	
Do	3117	1.968	98.23	71.49	28.51	33.3	Mixed.
Do	3119	2.897	92.22	68.51	31.49	31.9	Brown.
Do	3122	1.860	90.56	67.27	32.73	29.9	Light.
Tennessee	3302	1.897	99.29	68.24	31.76	31.4	Brown.
Do	3303	2.378	91.39	68.75	31.25	38.3	Do.
Do	3304	2.920	97.11	67.66	32.34	35.5	Do.
Do	3309	2.160	94.86	57.01	42.99	39.9	Do.
Georgia	3047	2.236	98.44	70.95	29.05	33.4	Light.
Do	3049	3.255	97.39	68.88	31.12	.....	
Do	3049[1]	2.388	91.34	71.18	28.82	.....	
Do	3049[2]	.....	91.64	73.52	26.48	.....	
Do	3050	2.609	96.42	65.17	34.83	31.4	Brown.
Do	3052	2.830	90.99	67.78	32.22	32.0	Do.
Do	3395	2.334	94.29	62.47	37.53	29.6	Do.
Florida	3041	2.880	99.69	67.13	32.87	31.5	Brown.
Do	3043	2.018	98.70	68.61	31.39	26.9	Yellow.
Do	3044	2.966	93.95	71.69	28.31	31.0	Brown
Do	3045	2.531	98.26	69.40	30.60	31.5	Do.
Do	3392	2.315	98.33	67.85	32.15	24.2	Yellow.
Alabama	3001	2.924	97.36	.....	.....	32.0	Brown.
Do	3002	3.068	97.23	68.34	31.66	24.7	Do.
Do	3007	2.498	94.86	66.48	33.52	32.4	Do.
Do	3008	3.127	94.10	69.39	30.61	36.0	Do.
Do	3363	3.190	98.81	68.47	31.53	33.3	Do.
Mississippi	3181	3.034	96.50	69.50	30.50	34.5	Do.
Do	3183	2.950	96.50	67.80	32.20	34.8	Do.
Do	3184	2.792	91.20	73.69	26.31	30.1	Do.
Do	3185	2.113	70.00	74.60	25.40	38.2	Do.
Do	3187	2.868	97.80	67.00	33.00	34.4	Do.
Louisiana	3126	2.993	99.29	69.34	30.66	33.0	Do.
Do	3127	2.775	90.03	68.19	31.81	35.3	Do.
Do	3441	3.104	95.65	72.16	27.84	42.6	Do.
Arkansas	3012	.....	.....	.....	.....	36.5	Do.
Do	3368	2.760	97.08	64.10	35.90	33.8	Do.
Texas	3310	3.055	98.62	70.18	29.82	31.4	Yellow.
Do	3311	2.491	96.48	71.79	28.21	34.8	Brown.
Do	3313	2.920	96.37	73.51	26.49	34.8	Do.
Do	3314	2.841	98.73	69.78	30.22	37.6	Do.

Physical properties of oats—Continued.

State.	Serial number.	Weight of 100 grains.	Clean grain.	Hulled grain.	Hulls.	Weight per bushel.	Color.
		Grams.	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds.*	
Texas	3315	3.030	93.86	70.74	29.26	41.6	Brown.
Do	3316	2.903	92.90	71.22	28.78	37.3	Do.
Do	3317	3.169	96.76	72.78	27.22	39.7	Do.
Do	3430	2.981	96.64	72.49	27.51	34.6	Do.
Colorado	3020	2.958	86.61	69.76	30.24	48.8	White.
Do	3021	2.247	.....	69.32	30.68	42.4	Light.
Do	3385	2.163	93.70	70.31	29.69	38.6	White.
Utah	3319	2.560	90.72	61.17	38.83	43.6	White.
Nevada	3205	2.019	95.05	66.01	33.99	41.1	White.
New Mexico	3218	2.462	97.67	73.21	26.79	43.9	Brown.
Do	3420	.....	.....	.....	.....	39.6	Mixed.
Washington Territory	3341	3.255	98.48	72.91	27.09	43.5	White.
Do	3435	3.148	97.16	79.28	20.72	43.2	Light brown.
Oregon	3275	2.772	96.85	73.09	26.91	46.9	White.
Do	3277	3.786	97.09	59.15	40.85	43.3	Do.

From the preceding tables it appears that in the North white (including in this color yellow), black and white, and black oats are principally sown, while in the South varieties of the red rust proof are almost entirely grown.

In the North the crop is put in in April or May and harvested in July or August. In the South it is sown from November to January and harvested in May or June.

The difference in appearance is marked between the crops of these two sections of the country. The Southern oats are large, light, awned varieties, of reddish brown color, with inflated husks not nearly filled by the kernel. The Northern grain is smaller, more compact, not often awned, and with the husk in the better samples well filled out.

Notwithstanding these characteristics, we learn from averages of the results that the size and weight of the Southern clean kernel is rather larger than the Northern. Its fluffy husk, however, makes them lighter oats in weight per bushel.

The averages have been calculated for various sections as follows: The Northern States include all north of Maryland and Kentucky, together with Missouri, Montana, and Dakota; the Southern, all south of these; and the Pacific slope, Colorado, Nevada, New Mexico, Washington Territory, Oregon, and Utah; the Atlantic slope consists of the States east of the Ohio river and the Gulf; the Western States, of those west of this line, excepting those on the Pacific slope. The same classification is preserved with the other cereals.

Average physical properties of oats.

State.	Number of specimens.	Weight of 100 kernels.	Clean grain.	Hulled grain.	Hulls.	Weight per bushel.
			Per cent.	*Per cent.*	*Per cent.*	*Lbs.*
United States	166	2.507	95.00	69.97	30.03	37.2
Northern States	90	2.299	95.63	70.60	29.30	38.0
Southern States	66	2.928	94.18	69.08	30.92	34.5
Pacific Slope	20	2.737	94.93	69.52	30.48	43.2
Atlantic Slope	58	2.523	95.37	69.69	30.31	37.0
Western States	61	2.339	95.82	72.20	27.80	37.8
Maine	3	2.344	97.38	70.29	29.71	38.6
New Hampshire	3	2.472	93.83	71.54	28.46	38.3
Vermont	4	2.474	94.97	69.52	30.48	39.4
Connecticut	4	2.110	95.78	67.44	32.56	35.6
Rhode Island	1	3.029	97.16	67.27	32.73	32.3
New York	8	2.571	95.32	71.00	29.00	39.8
New Jersey	2	2.371	98.50	72.75	27.25	36.6
Pennsylvania	4	2.686	92.24	68.55	31.45	38.0
Ohio	9	2.256	96.42	71.44	28.56	39.8
Michigan	6	2.767	96.22	72.31	27.69	42.3
Indiana	3	2.188	93.36	72.00	28.00	36.7
Illinois	9	2.350	97.21	72.02	27.98	39.4
Wisconsin	5	2.487	94.81	70.77	29.23	39.0
Minnesota	9	2.416	96.09	71.67	28.33	43.6
Iowa	6	2.245	96.99	71.63	28.37	38.4
Missouri	3	1.867	98.13	69.78	30.22	37.8
Nebraska	3	1.763	97.87	70.10	29.90	33.1
Dakota	5	2.519	92.92	66.20	33.80	43.3
Montana	3	2.410	91.06	70.54	29.46	30.0
Maryland	2	2.244	93.26	71.53	28.47	37.5
Delaware	1	1.976	98.04	69.69	30.41	.....
Virginia	3	2.657	94.67	65.23	34.77	39.2
West Virginia	4	2.500	95.94	66.48	33.52	39.2
North Carolina	6	2.496	94.52	70.37	29.63	39.8
South Carolina	8	2.767	95.99	69.52	30.48	38.4
Kentucky	4	2.249	94.88	69.99	30.01	31.7
Tennessee	4	2.089	95.66	65.42	34.58	36.3
Georgia	7	2.609	93.39	68.56	31.44	31.6
Florida	5	2.542	97.79	68.94	31.06	29.0
Alabama	5	2.961	96.47	68.17	31.83	31.7
Mississippi	5	2.751	90.40	70.52	29.48	34.4
Louisiana	3	2.957	94.99	69.90	30.10	36.9
Arkansas	1	2.760	97.08	64.10	35.90	35.2
Colorado	3	2.442	90.16	69.80	30.21	43.3
Texas	8	2.924	96.29	71.56	28.44	36.5
Utah	3	2.560	90.72	61.17	38.83	43.6
Nevada	1	2.019	95.05	66.01	33.99	41.1
New Mexico	1	2.462	97.67	73.21	26.79	41.8
Washington Territory	2	3.602	98.34	76.10	23.90	43.4
Oregon	2	3.279	96.97	66.12	33.88	45.1

Oats having the husk (pallets and at times glumes) adherent is necessarily lighter than wheat in weight per hundred grains. The heaviest is from the Pacific slope, and the South ranks next, owing, as has been said, to its large size. In weight per bushel, however, the fluffy husk of the Southern grain makes it the lowest in the country, while the Pacific slope retains the highest weight per bushel, as also size and weight per 100, showing it to have a plump, well-filled grain.

The average for the country, 37.2 pounds, appears rather high in comparison with the most common legal weight, 32 pounds, but, as in the case of wheat, the determinations have been proved correct for the specimens examined, and are not mere estimates. The samples are, too, apparently fair averages, as the figures giving percentages of clean grain in the specimens as received show that no particular pains was taken to prepare them for exhibition before reaching us. The range

with this cereal is larger than with any other. The extremes in weight per 100 grains were, serial No. 3200, the lightest, from Nebraska, 1.582 grams, and serial No. 3277, from Oregon, the heaviest, 3.786 grams. Cleanliness varied from 99.8 per cent. to 70.0 per cent., but of course had nothing to do with locality. The heaviest weight per bushel was found in specimens from Colorado, serial No. 3020, and Dakota, serial No. 3036, weighing 48.8 and 48.6 pounds. The lightest were from Alabama, serial No. 3002, and from Florida, serial No. 3043, 24.7 and 26.9 pounds, respectively.

In milling oats the relation of kernel to waste is about one-half. Our results show that the relation of kernel to husk averages for the whole country 7 to 3, those from the Western States being a little less husky, and those from the South considerably more so. It is, however, the inflated nature of the husk in the Southern grain and the fact that the glumes or outer husk is often adherent that affects the weight per bushel more than the slightly larger proportion.

The extremes found were 79.28 per cent. of kernel in a specimen from Washington Territory, serial No. 3435, and 55.37 per cent. in one from Dakota, serial No. 3391. Washington and Oregon sustain their reputation for fine looking grain, while the small proportion of kernel in the Dakota specimen is due entirely to cutting before it was quite ripened. It is hardly a fair example, other specimens from the Territory reaching over 70.0 per cent. of kernel.

In weight per bushel the warm climate of the South so affects the form of the grain as to lower its average 2.7 pounds. This is hardly as large as would be expected, and leads to the conclusion that the climate has a greater effect than some other characteristics. One of these is yield, which, from an average of 30 bushels in the North, falls to about 10 in the South, and, as has been said, the color and shape of the grain is much changed.

CHEMICAL COMPOSITION.

In examining the physical relations of the specimens they were separated into kernel and husk, and for several reasons they were separately submitted to analysis with, as it appears, results furnishing much more information than would otherwise have been obtained. Corn, wheat, and rye were analyzed in the clean kernel, and comparison is more readily made between them and oats. The variations, independent of the proportion of husk, are easily arrived at, and since the analysis of the hull and its relative amount are given it is easy to calculate for any specimen its composition as it would be used for feed.

The data obtained are here presented, together with averages derived therefrom:

Composition of American oats, arranged by States.

State.	Serial No.	Water.	Ash.	Oil.	Carbohydrates.	Fiber.	Albuminoids.	Nitrogen.
		Pr. ct.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
Maine	3131	7.20	1.80	9.03	66.65	1.67	13.65	2.18
	3133	7.26	2.29	8.54	66.41	1.85	13.65	2.18
	3134	7.19	1.64	8.08	66.15	1.80	15.23	2.44
New Hampshire	3208	7.20	2.13	8.41	65.11	1.40	15.75	2.52
	3209	7.02	2.31	8.46	66.10	1.23	14.88	2.38
	3210	6.95	2.45	8.21	64.61	1.33	16.45	2.63
Vermont	3322	7.60	2.09	8.65	65.76	1.26	14.70	2.35
	3323	7.00	2.06	8.12	63.16	1.46	18.20	2.91
	3324	6.15	1.70	8.30	67.85	1.30	14.70	2.35
	3326	6.58	2.26	7.15	67.81	1.42	14.88	2.38
Connecticut	3024	6.24	2.30	7.54	67.56	1.48	14.88	2.38
	3027	6.52	2.20	8.23	69.27	1.53	12.25	1.96
	3028	7.62	2.25	8.72	67.46	1.35	12.60	2.02
	3029	5.77	2.46	7.74	67.99	1.51	14.53	2.32
Rhode Island	3294	7.52	2.02	8.71	68.66	1.01	12.08	1.93
New York	3226	7.33	2.09	8.13	69.07	1.48	11.90	1.90
	3228	7.20	2.15	7.15	67.56	1.22	14.35	2.30
	3230	7.50	2.20	8.46	66.01	1.48	14.35	2.30
	3231	7.46	2.43	8.01	64.81	1.54	15.75	2.52
	3232	7.20	2.37	7.13	66.24	1.31	15.75	2.52
	3233	7.58	2.23	7.79	67.50	1.89	12.95	2.07
	3234	9.24	1.93	9.63	64.88	1.19	13.13	2.10
	3235	7.28	1.78	8.52	67.74	1.20	13.48	2.18
	3243	6.34	2.03	6.98	65.02	1.60	18.03	2.88
New Jersey	3214	7.26	2.34	6.86	67.18	1.31	15.05	2.41
	3215	7.57	2.24	7.42	65.93	1.26	15.58	2.49
Pennsylvania	3282	6.73	2.64	8.41	62.91	1.43	17.88	2.85
	3285	6.86	2.08	8.08	67.82	.98	14.18	2.27
	3286	7.88	2.30	7.90	67.02	1.25	13.05	2.18
	3286	6.92	2.40	7.62	65.67	1.64	15.75	2.52
Ohio	3260	7.04	2.43	7.75	66.29	1.23	15.26	2.44
	3261	7.00	1.92	8.01	64.11	1.46	17.50	2.80
	3262	6.78	2.07	7.40	63.21	1.10	19.44	3.11
	3267	6.45	1.96	8.67	64.80	.97	17.15	2.74
	3268	6.76	2.65	8.67	64.56	1.26	16.10	2.58
	3269	6.83	2.12	8.85	66.84	1.18	14.18	2.27
	3270	6.77	2.20	8.88	66.37	1.25	14.53	2.32
	3271	6.71	2.40	8.34	66.13	1.19	15.23	2.44
	3444	6.55	2.50	8.33	66.19	1.03	15.40	2.46
Michigan	3151	7.95	2.10	8.42	65.55	1.10	14.88	2.38
	3153	6.67	2.94	7.42	65.43	1.26	16.28	2.60
	3156	6.89	2.57	7.40	68.15	1.16	13.83	2.21
	3158	7.44	2.06	7.48	68.31	1.23	13.48	2.16
	3160	7.10	2.33	7.52	67.69	1.18	14.18	2.27
	3406	6.66	2.12	8.17	70.50	1.23	11.38	1.82
Indiana	3084	8.15	1.65	7.40	66.25	1.15	15.40	2.46
	3086	7.29	2.13	8.23	65.99	1.16	16.10	2.58
	3089	8.72	1.98	7.83	65.72	1.40	14.35	2.30
Illinois	3055	6.18	2.66	7.22	68.38	1.38	14.18	2.27
	3060	5.88	2.16	7.59	68.82	1.55	14.00	2.24
	3062	7.00	2.64	7.09	67.89	1.55	13.83	2.21
	3063	5.41	2.24	8.12	67.95	1.40	14.88	2.38
	3065	6.29	2.66	8.09	66.53	1.80	15.23	2.44
	3066	5.28	2.49	7.23	67.27	1.98	15.75	2.52
	3067	6.11	2.42	7.76	68.34	1.43	14.00	2.24
	3068	6.60	2.15	7.85	67.62	1.43	14.35	2.30
	3068	6.92	2.37	7.82	66.41	1.43	15.05	2.41
Wisconsin	3351	6.82	2.30	7.35	68.14	1.56	13.83	2.21
	3353	7.84	2.28	7.82	68.90	1.26	11.90	1.90
	3357	6.86	2.02	7.55	69.58	1.39	12.60	2.02
	3360	7.12	1.45	7.32	67.83	1.75	14.53	2.32
	3361	7.72	2.25	7.21	67.82	1.48	13.48	2.16
Minnesota	3166	6.69	2.15	8.24	69.36	1.30	12.25	1.96
	3168	7.15	2.45	8.70	66.35	1.17	14.18	2.27
	3169	7.63	2.35	7.30	69.11	1.01	12.60	2.02
	3170	6.88	2.23	7.90	66.26	1.33	15.40	2.46
	3172	8.07	2.18	7.97	68.09	1.09	12.60	2.02
	3175	7.07	2.38	7.73	67.52	1.47	13.83	2.21
	3175	6.95	2.10	7.88	67.75	1.84	13.48	2.16
	3176	6.82	2.38	7.61	71.22	1.29	10.68	1.71
	3179	7.15	2.19	7.90	69.32	1.19	12.25	1.96
Iowa	3094	6.46	1.92	6.94	65.50	1.50	17.68	2.86
	3097	6.40	2.07	7.75	69.44	1.04	13.30	2.13
	3098	7.38	2.61	9.60	65.15	1.08	14.18	2.27

Composition of American oats, asranged by States—Continued.

State.	Serial No.	Water.	Ash.	Oil.	Carbohydrates.	Fiber.	Albuminoids.	Nitrogen.
		Pr. ct.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
Iowa	3101	6.56	2.06	7.88	68.66	1.71	13.13	2.10
	3104	7.66	.84	7.96	67.06	1.60	14.88	2.38
	3107	7.98	2.32	7.93	65.20	1.69	14.88	2.38
	3445	6.65	2.35	8.07	66.06	1.47	15.40	2.46
Missouri	3190	6.81	2.07	8.95	67.42	1.45	13.30	2.13
	3191	7.58	2.07	8.34	66.33	1.50	14.18	2.27
	3411	6.95	1.60	7.77	62.86	1.57	19.25	3.08
Nebraska	3198	8.03	2.02	6.91	66.81	1.35	14.88	2.38
	3200	6.90	2.21	8.32	66.72	1.85	14.00	2.24
	3200	7.32	2.24	8.72	66.39	1.33	14.00	2.24
Dakota	3030	6.12	2.27	8.27	68.67	1.37	13.30	2.13
	3035	6.38	2.29	8.12	67.86	1.35	14.00	2.24
	3036	5.90	2.46	7.00	66.11	1.03	17.50	2.80
	3390	6.54	2.08	7.94	68.16	1.10	14.18	2.27
	3391	8.75	2.15	9.47	66.17	1.56	11.90	1.90
Montana	3196	7.10	2.18	8.79	66.39	1.54	14.00	2.24
	3197	7.10	2.26	9.72	67.87	1.32	11.73	1.88
	3415	11.13	2.15	9.03	64.42	1.02	12.25	1.96
Maryland	3140	6.32	2.31	8.48	65.59	1.55	15.75	2.52
	3141	7.70	2.40	7.35	67.19	1.36	14.00	2.24
Delaware	3038	5.94	2.27	7.75	66.09	1.35	16.60	2.66
Virginia	3331	6.73	2.45	9.39	66.76	1.42	13.65	2.18
	3334	6.43	2.53	7.25	66.20	1.14	16.45	2.63
	3335	6.13	2.35	8.58	66.55	1.51	14.88	2.38
	3337	7.24	2.80	6.50	64.58	1.90	16.98	2.72
West Virginia	3345	6.45	2.32	8.65	64.94	1.54	16.10	2.58
	3346	7.10	2.14	7.34	65.63	1.34	16.45	2.63
	3347	6.45	2.19	7.42	63.84	1.37	18.73	3.00
	3348	6.57	2.50	6.62	65.03	1.60	17.68	2.86
North Carolina	3249	7.78	2.02	7.32	71.91	1.87	9.10	1.46
	3251	6.34	2.56	8.68	66.00	1.54	14.88	2.38
	3253	6.82	2.19	8.64	67.59	1.11	13.65	2.18
	3255	6.77	1.83	6.92	69.18	2.00	13.30	2.13
	3256	6.77	1.80	9.77	67.08	1.63	12.95	2.07
	3257	6.58	1.98	8.26	67.91	1.62	13.65	2.18
South Carolina	3295	6.16	2.18	8.65	68.50	1.03	13.48	2.16
	3296	6.94	1.76	9.51	68.40	1.14	12.25	1.96
	3297	7.90	1.86	7.15	69.04	.92	13.13	2.10
	3298	7.08	1.93	8.13	68.20	1.01	13.65	2.18
	3299	6.62	1.74	9.55	67.31	1.13	13.65	2.18
	3300	7.02	2.06	8.59	68.15	.88	13.30	2.13
	3301	7.40	2.16	7.97	68.09	.90	13.48	2.16
	3429	7.40	3.00	8.31	67.90	.96	12.43	1.99
Kentucky	3116	8.03	2.02	7.36	65.22	1.62	15.75	2.52
	3117	7.25	1.95	9.39	65.33	2.08	14.00	2.24
	3119	6.72	2.43	6.90	68.41	1.19	14.35	2.30
	3122	7.37	2.00	7.55	64.92	2.06	16.10	2.58
Tennessee	3302	6.80	2.20	7.59	66.13	1.53	15.75	2.52
	3303	6.66	1.88	8.03	68.36	1.34	13.13	2.10
	3304	6.81	2.74	7.07	67.63	1.40	14.35	2.30
	3390	6.96	2.04	9.07	67.21	1.42	13.30	2.13
Georgia	3047	6.14	3.07	8.44	68.12	1.28	12.95	2.07
	3049	7.24	1.78	8.93	67.45	1.12	13.48	2.16
	3049	4.88	2.23	8.92	68.17	.92	14.88	2.38
	3049	7.28	1.93	7.72	65.92	1.22	15.93	2.55
	3049	6.57	2.02	8.64	67.23	1.36	14.18	2.27
	3050	4.85	1.85	8.03	69.28	1.81	14.18	2.27
	3052	5.82	2.30	7.26	70.40	1.44	12.78	2.04
	3395	6.40	2.25	10.38	64.61	1.66	14.70	2.35
Florida	3041	5.83	2.52	7.68	68.93	1.56	13.48	2.16
	3043	6.09	1.60	8.32	66.50	1.39	16.10	2.58
	3044	6.32	2.25	7.68	68.32	.90	14.53	2.32
	3045	5.93	2.38	8.25	68.93	1.56	12.95	2.07
	3392	5.99	1.65	10.51	66.57	1.45	13.83	2.21
Alabama	3001	5.11	2.30	8.20	68.65	1.04	14.70	2.35
	3002	6.59	1.80	8.98	66 20	1.20	15 23	2.44
	3007	6.28	1.55	8.95	66.92	1.07	15.23	2.44
	3008	7.24	2.10	7.89	68.29	1.00	13.48	2.16
	3363	6.78	1.94	8.08	67.68	1.52	14.00	2.24
Mississippi	3181	7.53	1.97	7.67	68.49	1.21	13.13	2.10
	3183	7.13	2.14	7.61	67.99	1.13	14.00	2.24
	3184	8.10	1.69	8.06	66.16	1.29	14.70	2.35
	3185	7.05	2.10	7.81	67.32	1.54	14.18	2.27
	3187	7.21	1.95	8.15	67.46	1.23	14.00	2.24

Composition of American oats, arranged by States—Continued.

State.	Serial No.	Water.	Ash.	Oil.	Carbohydrates.	Fiber.	Albuminoids.	Nitrogen.
		Per ct.	*P. ct.*	*Per ct.*	*Per ct.*	*P. ct.*	*Per ct.*	*P. ct.*
Louisiana	3126	9.50	2.20	8.18	64.99	1.13	14.00	2.24
	3127	8.00	2.10	7.83	67.72	1.05	13.30	2.13
	3441	6.85	2.10	8.25	66.93	1.34	14.53	2.32
Arkansas	3012	4.67	2.10	8.12	69.35	1.93	13.83	2.21
	3368	6.94	2.14	7.71	65.83	1.63	15.75	2.52
Texas	3310	7.08	1.74	8.09	68.07	1.12	13.30	2.13
	3311	6.92	2.08	11.26	65.24	1.55	12.95	2.07
	3313	8.57	2.15	9.06	62.82	1.65	15.75	2.52
	3314	6.70	1.86	8.80	67.26	1.03	14.35	2.30
	3315	7.14	2.26	8.75	67.58	1.14	13.13	2.10
	3316	6.80	1.82	8.08	68.62	1.20	13.48	2.16
	3317	6.95	2.10	8.19	68.63	.83	13.30	2.13
	3430	7.10	2.30	7.45	67.81	1.16	14.18	2.27
Colorado	3020	4.80	2.08	7.27	66.82	1.00	18.03	2.88
	3021	5.08	2.40	8.67	68.98	1.14	13.13	2.10
	3385	6.56	2.29	7.67	65.75	1.10	16.63	2.66
	3583	7.20	2.45	7.59	68.46	1.17	13.13	2.10
Utah	3319	6.05	2.37	8.17	69.71	1.62	12.08	1.93
	3321	7.30	2.40	8.81	66.89	1.82	12.78	2.04
Nevada	3205	6.80	2.27	9.72	66.21	1.17	13.83	2.21
New Mexico	3218	6.61	2.12	9.89	66.02	1.88	13.48	2.16
	3420	7.05	2.50	9.43	66.30	1.59	13.13	2.10
Washington	3341	7.08	1.79	7.99	71.56	1.95	9.63	1.54
	3435	6.55	1.55	10.57	68.36	1.07	11.90	1.90
Oregon	3275	6.72	2.28	8.89	68.73	1.48	11.90	1.90
	3277	7.01	2.42	7.87	66.80	2.07	13.83	2.21
California	3016	7.95	1.93	8.83	66.33	1.83	13.13	2.10
	3374	7.22	1.58	9.67	67.94	1.86	11.73	1.88
	3378	6.58	1.79	10.10	70.02	1.88	9.63	1.54
	3380	6.52	2.14	9.11	66.35	1.70	14.18	2.27
	3382	7.12	1.35	9.32	68.86	1.27	12.08	1.93

Composition of hulls of American oats, arranged by States.

State.	Serial No.	Water.	Ash.	Undetermined.	Fiber.	Albuminoids.	Nitrogen.
		Per ct.	*P. ct.*	*Per ct.*	*Per ct.*	*P. ct.*	*P. ct.*
Maine	3133	4.60	4.30	65.99	23.36	1.75	.28
New Hampshire	3208	6.46	4.50	66.50	19.56	2.98	.48
	3209	3.90	4.36	70.48	19.16	2.10	.34
	3210	4.30	5.00	67.59	20.13	2.98	.48
Vermont	3322	4.08	5.40	68.99	18.20	3.33	.53
	3323	4.80	4.10	68.74	19.73	2.63	.42
	3324	3.60	3.60	73.59	17.46	1.75	.28
	3326	4.14	3.66	72.98	16.94	2.28	.36
Connecticut	3024	6.60	5.95	65.37	19.86	2.28	.36
	3028	5.60	4.44	67.13	20.20	2.63	.42
	3029	5.74	3.71	69.69	18.06	2.80	.45
Rhode Island	3294	5.00	4.50	73.12	15.10	2.28	.36
New York	3226	4.70	4.00	72.07	16.43	2.80	.45
	3231	4.50	4.90	68.52	18.93	3.15	.50
	3235	.....	.....	.....	.....	1.75	.28
	3243	5.00	4.40	74.02	13.95	2.63	.42
New Jersey	3214	2.90	6.30	68.46	19.19	3.15	.50
Pennsylvania	3282	3.68	4.30	70.54	18.85	2.63	.42
	3286	4.36	4.50	70.11	18.40	2.63	.42
	3286	4.30	3.20	69.10	21.15	1.75	.28
Ohio	3260	3.18	7.40	66.99	20.68	1.75	.28
	3261	3.52	5.60	70.54	16.84	3.50	.56
	3262	4.84	4.20	72.08	15.55	3.33	.53
	3267	5.58	5.80	69.57	17.12	1.93	.31
	3269	5.12	5.30	68.30	18.30	2.98	.48
	3270	4.84	7.70	66.80	18.56	2.10	.34
	3444	5.00	6.80	.....	.....	2.28	.36
Michigan	3153	4.96	3.84	68.55	20.02	2.63	.42
	3156	3.83	6.33	63.96	23.78	2.10	.34
	3158	4.82	5.20	69.55	18.50	1.93	.31
	3406	4.44	6.40	71.38	16.38	1.40	.22

Composition of hulls of American oats, arranged by States—Continued.

States.	Serial No.	Water.	Ash.	Undetermined.	Fiber.	Albuminoids.	Nitrogen.
		Per ct.	*P. ct.*	*Per ct.*	*Per ct.*	*P. ct.*	*P. ct.*
Indiana	3084	4.80	5.20	68.17	19.38	2.45	.39
Illinois	3055	.....	.....	.....	.....	2.10	.34
	3060	4.42	7.10	64.80	21.40	2.28	.36
	3062	7.70	5.70	67.31	14.56	4.73	.76
	3063	15.16	7.80	52.62	21.44	2.98	.48
	3067	5.16	7.20	67.44	17.92	2.28	.36
	3068	4.56	7.44	71.41	14.14	2.45	.39
	3068	5.12	5.88	65.78	21.12	2.10	.34
Wisconsin	3353	4.40	7.10	70.40	15.45	2.63	.42
	3357	4.70	6.90	69.11	17.71	1.58	.25
	3360	3.56	5.80	71.00	17.54	2.10	.34
	3361	2.20	6.50	70.35	19.20	1.75	.28
Minnesota	3166	4.71	7.10	64.41	21.85	1.93	.31
	3170	4.35	6.21	68.27	18.44	2.63	.42
	3172	5.36	5.40	68.75	18.04	2.45	.39
	3175	4.96	7.35	.....	.....	1.75	.28
	3176	6.54	7.00	67.70	16.76	2.10	.34
Iowa	3098	5.20	8.40	.....	.....	1.75	.28
	3104	4.50	6.22	64.70	22.14	2.45	.39
	3107	6.00	6.66	69.37	16.22	1.75	.28
Missouri	3191	5.13	6.55	69.11	16.58	2.63	.42
	3411	4.30	5.90	70.60	15.87	3.33	.53
Nebraska	3198	4.10	7.80	68.40	17.60	2.10	.34
Dakota	3035	.....	.....	.....	18.12	1.75	.28
	3390	5.40	7.70	66.50	18.12	2.28	.36
Montana	3197	3.00	9.50	65.82	17.65	4.03	.64
	3415	4.40	4.48	70.25	19.12	1.75	.28
Maryland	3140	4.40	5.62	67.82	17.43	4.73	.76
	3141	4.00	4.62	64.68	24.42	2.28	.36
Delaware	3038	.....	.....	.....	16.54	3.15	.50
Virginia	3334	3.08	3.90	74.41	16.16	2.45	.39
	3335	4.06	5.50	69.94	17.52	2.98	.48
	3337	5.10	3.70	64.97	23.42	2.81	.45
West Virginia	3345	4.30	5.60	67.38	20.62	2.10	.34
	3347	3.76	3.60	72.32	17.69	2.63	.42
North Carolina	3249	5.80	4.70	70.61	15.04	3.85	.62
	3251	.....	.....	.....	.....	2.80	.45
	3253	4.30	7.50	69.86	15.89	2.45	.39
	3255	5.40	6.50	72.13	12.82	3.15	.50
	3256	4.76	5.00	68.16	19.80	2.28	.36
	3257	4.82	5.90	71.63	15.37	2.28	.36
South Carolina	3295	3.86	3.90	76.64	13.50	2.10	.34
	3297	2.98	5.00	75.32	14.95	1.75	.28
	3299	1.10	5.40	73.62	13.90	2.98	.48
	3000	4.20	8.10	70.55	15.40	1.75	.28
	3402	6.00	5.80	71.21	11.91	5.08	.81
Kentucky	3116	5.10	4.80	64.80	23.55	1.75	.28
	3117	17.40	4.90	57.13	17.17	2.80	.45
	3122	9.90	5.30	60.68	19.22	4.90	.78
Tennessee	3304	8.90	6.50	67.30	14.85	2.45	.39
	3309	4.86	5.50	65.91	21.63	2.10	.34
Georgia	3047	5.71	5.31	68.47	18.06	2.45	.39
	3049	5.96	5.76	70.51	16.06	1.75	.28
	3049	5.70	5.15	71.24	15.46	2.45	.39
	3050	5.30	4.00	69.50	19.10	2.10	.34
	3052	5.50	4.40	67.17	20.48	2.45	.39
	3395	5.02	6.06	70.16	14.56	4.20	.67
Florida	3044	5.50	1.90	73.39	16.58	2.63	.42
	3045	5.78	2.98	74.79	14.70	1.75	.28
	3392	3.30	3.86	75.13	15.26	2.45	.39
Alabama	3002	14.94	4.80	63.17	14.75	2.28	.36
	3363	4.50	5.10	68.18	20.12	2.10	.34
Mississippi	3185	5.20	7.80	67.70	16.67	2.63	.42
	3187	5.40	6.75	68.20	17.72	1.93	.31
Louisiana	3126	15.60	4.60	58.13	19.57	2.10	.34
	3127	5.00	5.20	68.62	18.90	2.28	.36
Arkansas	3012	6.00	5.14	62.77	16.80	2.98	.48
Texas	3310	4.40	7.60	66.83	20.12	1.05	.17
	3311	4.20	6.20	72.62	14.35	2.63	.42
	3313	4.00	7.10	72.10	14.70	2.10	.34
	3315	3.90	7.70	.....	.....	2.63	.42
	3317	3.30	7.70	71.95	15.30	1.75	.28
	3430	4.40	7.50	71.56	15.31	1.23	.20
Colorado	3385	4.30	7.84	67.71	17.56	2.63	.42
	3583	4.04	5.40	65.92	22.54	2.10	.34
Utah	3321	4.70	.....	.....	20.59	3.50	.56
Washington Tetritory	3135	5.20	7.16	67.37	18.34	1.93	.31
Oregon	3277	5.12	4.80	71.37	16.96	1.75	.28
California	3374	4.20	6.02	71.63	16.40	1.75	.28

Average composition of American oats, arranged by States.

States.	Number of analyses.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.
United States	179	6.93	2.15	8 14	67.09	1.38	14.31	2.28
Atlantic Slope	64	6.84	2.17	8.22	67.10	1.37	14.30	2.28
Northern States	92	7.07	2.19	8.02	66.88	1.37	14.47	2.32
Western States	54	6.98	2.19	7.91	67.06	1.37	14.49	2.32
Southern States	69	6.79	2.12	8.23	67.22	1.35	14.29	2.28
Northwestern States	8	7.38	2.23	8.54	66.96	1.28	13 61	2.18
Pacific Slope	18	6.71	2.10	8.87	67.78	1.53	13.01	2.08
Maine	3	7.19	1.91	8.55	66.40	1.77	14.18	2.27
New Hampshire	3	7.06	2.30	8.36	65.27	1.32	15.69	2.51
Vermont	4	6.33	2.00	8.06	66.15	1.34	15.62	2.50
Connecticut	4	6.54	2.30	8.06	68.07	1.47	13.56	2.17
Rhode Island	1	7.52	2.02	8.71	68.66	1.01	12.08	1.93
New York	9	7.46	2.14	8.02	66.53	1.44	14.41	2.31
New Jersey	2	7.42	2.29	7.14	66.55	1.29	15.31	2.45
Pennsylvania	4	7.10	2.36	8.00	65.85	1.32	15.37	2.46
Ohio	9	6.76	2.25	8.32	65.39	1.19	16.09	2.57
Michigan	6	7.11	2.35	7.74	67.61	1.19	14.00	2.24
Indiana	3	8.05	1.92	7.82	65.69	1.24	15.28	2.45
Illinois	9	6.19	2.34	7.64	67.69	1.55	14.59	2.34
Wisconsin	5	7.27	2.06	7.45	68.46	1.49	13.27	2.12
Minnesota	9	7.16	2.27	7.91	68.33	1.30	13.03	2.09
Iowa	7	7.01	2.03	8.02	66.72	1.44	14.78	2.37
Missouri	3	7.11	1.91	8.35	65.54	1.51	15.58	2.49
Nebraska	3	7.42	2.16	7.98	66.64	1.51	14.29	2.29
Dakota	5	6.74	2.25	8.16	67.39	1.28	14.28	2.27
Montana	3	8.44	2.20	9.18	66.23	1.29	12.66	2.03
Maryland	2	7.01	2.36	7.91	66.39	1.46	14.87	2.38
Delaware	1	5.94	2.27	7.75	66.09	1.35	16.60	2.66
Virginia	4	6.63	2.43	7.93	66.03	1.49	15.49	2.48
West Virginia	4	6.64	2.29	7.51	64.86	1.46	17.24	2.76
North Carolina	6	6.84	2.06	8.27	68.28	1.63	12.92	2.07
South Carolina	8	7.07	2.09	8.48	68.19	1.00	13.17	2.11
Kentucky	4	7.34	2.10	7.80	65.97	1.74	15.05	2.41
Tennessee	4	6.81	2.22	8.09	67.33	1.42	14.13	2.26
Georgia	8	6.15	2.28	8.54	67.65	1.35	14.13	2.26
Florida	5	6.03	2.08	8.49	67.85	1.37	14.18	2.27
Alabama	5	6.40	1.94	8.42	67.55	1.16	14.53	2.33
Mississippi	5	7.41	1.97	7.86	67.48	1.28	14.00	2.24
Louisiana	3	8.12	2.13	8.09	66 55	1.17	13.94	2.23
Arkansas	2	5.80	1.12	7.92	67.59	1.78	14.79	2.37
Texas	8	7.16	2.04	8.71	67.08	1.21	13.80	2.21
Colorado	4	6.06	2.31	7.80	67.50	1.10	15.23	2.44
Utah	2	6.67	2.39	8.49	68.30	1.72	12.43	1.99
Nevada	1	6.80	2.27	9.72	66.21	1.17	13.83	2.21
New Mexico	2	6.83	2.31	9.66	66.16	1.73	13.31	2.14
Washington Territory	2	6.82	1.67	9.28	69.96	1.51	10.76	1.72
Oregon	2	6.86	2.35	8.38	67.77	1.78	12.86	2.06
California	5	7.08	1.76	9.40	67.90	1.71	12.15	1.94

Average composition of hulls of oats, arranged by States.

State.	Number of analyses.	Water.	Ash.	Undetermined.	Fiber.	Albuminoids.	Nitrogen.
United States	100	5.22	5.59	68.83	17.88	2.48	.40
Atlantic Slope	43	4.73	4.78	70.35	17.50	2.64	.42
Northern States	52	4.89	5.69	68.52	18.42	2.48	.40
Western States	33	4.99	6.39	67.88	18.30	2.44	.39
Southern States	43	5.71	5.40	69.20	17.15	2.54	.41
Northwestern States	17	4.57	6.25	68.80	18.35	2.03	.33
Pacific Slope	2	5.16	5.98	67.87	19 15	1.84	.30
Maine	1	4.00	4.30	65.99	23.36	1.75	.28
New Hampshire	3	4.88	4.62	68.19	19.62	2.69	.43
Vermont	4	4.15	4.19	71.08	18.08	2.50	.40
Connecticut	3	5.98	4.70	67.40	19.35	2.57	.41
Rhode Island	1	5.00	4.50	73.12	15.10	2.28	.36
New York	3	4.73	4.43	71.54	16.44	2.86	.40
New Jersey	1	2.90	6.30	68.46	19.19	3.15	.50
Pennsylvania	3	4.28	4.00	69.92	19.47	2.33	.37

Average composition of hulls of oats, arranged by States—Continued.

State.	Number of analyses.	Water.	Ash.	Undetermined.	Fiber.	Albuminoids.	Nitrogen.
Ohio	6	4.51	6.00	69.05	17.84	2.60	.42
Michigan	4	4.51	5.44	68.36	19.67	2.02	.32
Indiana	1	4.80	5.20	68.17	19.38	2.45	.39
Illinois	6	7.01	6.85	64.90	18.43	2.81	.45
Wisconsin	4	3.71	6.58	70.22	17.48	2.01	.32
Minnesota	4	5.24	6.43	67.28	18.77	2.28	.36
Iowa	2	5.25	6.43	67.04	19.18	2.10	.34
Nebraska	1	4.10	7.80	68.40	17.60	2.10	.34
Missouri	2	4.72	6.23	69.85	16.22	2.98	.48
Dakota	1	5.40	7.70	66.50	18.12	2.28	.36
Montana	2	7.40	6.99	68.04	18.38	2.89	.46
Maryland	2	4.20	5.12	66.24	20.94	3.50	.56
Virginia	3	4.08	4.37	69.77	19.03	2.75	.44
West Virginia	2	4.03	4.60	69.85	19.16	2.36	.38
North Carolina	5	5.02	5.92	70.48	15.78	2.80	.45
South Carolina	5	4.23	5.64	73.47	13.93	2.73	.44
Kentucky	3	10.80	5.00	60.87	20.18	3.15	.50
Tennessee	2	6.88	6.00	66.61	18.24	2.27	.36
Georgia	6	5.53	5.13	69.51	17.28	2.57	.41
Florida	3	4.86	2.19	74.44	15.51	2.28	.36
Alabama	2	9.72	4.98	65.68	17.43	2.19	.35
Mississippi	2	5.30	7.28	67.95	17.19	2.28	.36
Louisiana	2	10.30	4.90	63.38	19.23	2.19	.35
Arkansas	1	6.00	5.14	69.08	16.80	2.98	.48
Texas	5	4.06	7.22	71.01	15.96	1.75	.28
Colorado	2	4.17	6.62	66.82	20.03	2.36	.38
Washington Territory	1	5.20	7.16	67.37	18.34	1.93	.31
Oregon	1	5.12	4.80	68.37	19.96	1.75	.28
California	1	4.20	6.02	71.63	16.40	1.75	.28

The chemical composition of the specimens appears from the preceding data to be rather surprising. It was reasonable to suppose that as oats deteriorate so readily, and are apparantly so easily influenced by their environment, great variations would be found in their composition under different climatic conditions, as is the case with wheats. Brewer remarks in his census report that a hundred or more analyses would be requisite to set at rest all questions in regard to this grain, and that they would be an extremely valuable contribution to our knowledge of the comparative nutritive values of the oats grown in different portions of the United States and their relative economic values. One hundred and seventy-nine analyses have been made, and we learn that there is not that variation in the oat kernel itself which was expected to be due to climatic condition. The proportion of husk to kernel and the compactness of the grain prove to be the all-important factors, and the weight per bushel the best means of judging of the value of the grain.

The only peculiarities noticed are that the eighteen specimens from the Pacific slope are lower in albuminoids and richer in fiber than the averages for other parts of the country. The average for the hulls from the West show the presence of more ash than in those from the East, and more fiber, and, like the kernels, they are slightly deficient in al-

buminoids. Actual analysis of the mixed remainder from the individual analyses of the hulls furnished the following results:

	North.	South.	West.
	Per ct.	*Per ct.*	*Per ct.*
Water	7.71	7.83	8.10
Ash	5.57	5.50	6.22
Oil	.79	.74	1.01
Undetermined	62.47	63.84	60.09
Crude fiber	20.83	19.64	21.45
Albuminoids	2.63	2.45	3.13
	100.00	100.00	100.00

The small number from the West contained rather more albuminoids than the average results for that part of the country, but for the other sections there is a close agreement. In these samples, oil was determined and found to be extremely small in amount, following the percentage of albuminoids, the largest amount of both of these constituents being in the Western hulls, and there seems to be a more or less intimate connection between them.

Of all the cereals this is the richest in oil and albuminoids, the average for the former being 8.14 per cent. and for the latter 14.31; of course diminished relatively in the grain as fed, the average composition of which would probably be, as calculated from the average for each portion—

	Kernel.	Hull.	Whole grain.
	Per cent.	*Per cent.*	*Per cent.*
Water	4.85	1.57	6.42
Ash	1.50	1.68	3.18
Oil	5.70	.24	5.94
Carbhydrates	46.96	20.41	67.37
Crude fiber	.97	5.36	6.33
Albuminoids	10.02	.74	10.76
	70.00	30.00	100.00

An average of 20 analyses of oats in the husk given by Brewer and 153 given by Koenig are given as follows for comparison:

	Brewer.	Koenig.	Richardson.
	Per cent.	*Per cent.*	*Per cent.*
Water	10.56	12.37	6.42
Ash	2.95	3.02	3.18
Oil	4.97	5.23	6.64
Carbhydrates	61.10	57.78	66.67
Crude fiber	9.01	11.19	6.33
Albuminoids	11.41	10.41	10.76

The average albuminoids in the grains as fed, calculated in this same manner, is as follows for different sections:

	Per cent.
Northern States	10.96
Southern States	10.66
Pacific slope	9.60
Atlantic slope	10.76
Western States	11.24

The lowness of the Pacific slope is purely climatic, as has been found to be the case with all the cereals. In appearance the oats from that section are the finest. The fullness of the husk in the Western States or the plumpness of the grain make this the richest in albuminoids as it is fed. The South is poorest for reasons which have been mentioned. That these figures are entirely dependent on the percentage of husk, and not on peculiarities of the kernel, a study of their analyses will show; for, among 179, only 3 fell below 10 per cent. of albuminoids, 4 below 11 per cent., and 12 below 12 per cent., while at the same time only 13 are above 17 per cent., and 23 above 16 per cent.; that is to say, all but 28, or 84.4 per cent., are within the limits of 12 and 16 per cent., a small variation, although the albuminoids are higher in amount than wheat; and as the averages for the different States and sections of the country do not vary far from 14.3 per cent., with the exception of the Pacific coast, oats cannot be said, as far as the grain itself is concerned, to be in chemical composition very susceptible to their environment, although extremes widely apart are found.

These were as follows:

Extremes in composition of kernels of oats.

	Highest.	State.	Lowest.	State.
	Per cent.		*Per cent.*	
Water	11.13	Montana	4.67	Arkansas.
Ash	2.94	Michigan	.87	Iowa.
Oil	11.20	Texas	6.50	Virginia.
Carbohydrates	71.91	North Carolina	62.82	Texas and Missouri.
Crude fiber	2.08	Kentucky and Oregon	.88	South Carolina.
Albuminoids	19.44	Ohio	9.10	North Carolina.

The highest percentage of albuminoids was 1.41 per cent. higher than has been found in any other cereal in this country, and the lowest 2 per cent. higher than was found in wheat.

The analysis of the heaviest and largest, of those having the greatest and least weight per bushel, of those having highest and lowest percentage of albuminoids and of the smallest in size and in weight per bushel, have been selected as a study of the effect of these contrasts on the chemical composition.

Composition of specimens exhibiting extreme characteristics.

	Serial number.	State.	Weight of 100 kernels.	Husk.	Weight per bushel.	Water.	Ash.	Oil.	C	Crude fiber.	Albuminoids.
			Gr'ms	*P. ct.*	*Lbs.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Smallest	3200	Nebr	1.512	31.21	29.7	7.32	2.24	8.72	66.39	1.33	14.00
Largest	3277	Oreg	3.786	40.85	43.3	7.01	2.42	7.87	66.80	2.07	13.83
Cleanest	3041	Fla	2.880	32.87	31.5	5.83	2.52	7.68	68.93	1.56	13.48
Chaffiest	3185	Miss	2.113	25.40	38.2	7.05	2.10	7.81	67.32	1.54	14.18
Highest per cent. of kernel	3435	Wash	3.148	20.72	43.2	6.55	1.55	10.57	68.36	1.07	11.90
Lowest per cent. of kernel	3391	Dak	2.372	44.63	38.8	8.75	2.15	9.47	66.17	1.56	11.90
Highest albuminoids	3262	Ohio	2.670	39.17	40.0	6.78	2.07	7.40	63.21	1.10	19.44
Lowest albuminoids	3249	N. C	2.660	29.50	47.8	7.78	2.02	7.32	71.91	1.87	9.10
Heaviest weight per bushel	3020	Col	2.958	30.24	48.8	4.80	2.08	7.27	66.82	1.00	18.03
Lightest weight per bushel	3002	Ala	3.068	31.66	24.7	6.59	1.80	8.98	66.20	1.20	15.23
Average weight for United States.		U. S	2.507	30.03	37.2	6.93	2.15	8.14	67.09	1.38	14.31

From the preceding figures nothing can be deduced which shows any such difference as we might expect between the largest and smallest oats, between the cleanest and most chaffy, or between those having the highest and lowest proportion of kernel in the grain. The weight per bushel of the specimen having the lowest percentage of albuminoids is extraordinarily high, while that containing the highest percentage is also above the average. Differences, too, between the weights per bushel of the extreme specimens are in no wise connected with their chemical composition. The largest and one of the finest and heaviest oats from Oregon had nearly the maximum of husk, and, while the lowest proportion of husk corresponded, of course, with a high weight per bushel, the largest proportion of husks was coincident with a weight per bushel above the average.

An immense number of conditions seem, therefore, to affect the characteristics of this grain, and while in many ways, at first glance, it seems to be less changeable than one would expect, on examination it seems to be quite largely influenced by all the circumstances of its environment, and in a more irregular way than wheat.

Throughout all the averages it will be seen that oats are much drier than other grains, owing largely to their small size. In ash and fiber they are not exceptionable.

Grown in the same locality, under similar conditions, two specimens of different varieties may vary considerably as was found to be the case with wheat. For examples the following determinations of albuminoids will serve:

State.	Serial No.	Albuminoids.
		Per cent.
Pennsylvania	3286_1	13.65
Pennsylvania	3286_2	15.75
Georgia	3049_1	13.48
Georgia	3049_2	14.88
Georgia	3049_3	15.93
Georgia	3049_4	14.18
Illinois	3068_1	14.35
Illinois	3068_2	15.05
Minnesota	3175_1	13.83
Minnesota	3175_2	13.48

In the last locality there is little difference; but there is no reason why in some cases, in fact many, there should not be an agreement where the varieties possess similar capabilities of assimilation.

One specimen, Serial No. 3200, from Nebraska, was by accident analyzed twice from the same bag. The results show the differences which may be expected in work of this kind which we have had in hand:

		No. 1.	No. 2.
Weight of 100 kernels	grams..	1.582	1.512
Clean grain	per cent..	97.20	97.40
Kernels	do....	68.30	68.79
Hulls	do....	31.70	31.21
Weight, per bushel	pounds..	30.2	29.7
Water	per cent..	6.90	7.32
Ash	do....	2.21	2.24
Oil	do....	8.32	8.72
Carbhydrates	do..	66.72	66.39
Crude fiber	do...	1.85	1.33
Albuminoids	do....	14.00	14.00

It may be said that the duplication was unknown to any one until after tabulation, and the coincidence in all the results, which are not variable in the preparation of the sample for analysis, was even better than is to be expected. Moisture, even in the tightest-stoppered bottles, is liable to change, as has been shown in previous reports, and with fiber, when present in so small amount, it is difficult to secure duplicates which will not at times differ as much as half of one per cent. Ash, oil, and albuminoids admit of determination with almost the accuracy of inorganic work.

A study of the analysis having shown that variations in chemical composition for any one season are not accompanied by any corresponding change in physical qualities, that the variations in any one locality are often quite as large as over the whole country, and that the Pacific coast alone produces a grain whose average composition is to any degree different from that of other States, it seems probable that the differences in composition are as largely due to soil as to other causes.

In this connection reference must be made to the recent valuable and instructive experiments with oats, conducted at the experiment at Halle, Germany, by Dr. Maercker, the results of which have appeared in the Zeitschrift des landwirthschaftlichen Verein der Provinz Sachsen, from which it has been learned that the condition of the soil and manures have a marked effect not only on the yield, but the composition of the crop.

The following are some of the valuable conclusions reached in 1883:

(1) 38 pounds of oats sown to the acre, in spite of a heavy application of artificial manure, was not able to give so high a product as the same area sown with 84 pounds.

(2) The application of phosphoric acid alone did not increase the product essentially, in spite of the fact that the experimental field was in good condition and did not suffer at all from the lack of nitrogen.

(3) The application of nitrogenous manure in general increased the product decidedly, proportional to the amount of applied nitrogen.

(4) Small or large quantities of phosphoric acid, together with weak nitrogenous manuring, furnished in the form of Chili saltpeter, showed themselves of paying efficacy.

(5) With strong nitrogenous manuring neither large nor small applications of phosphoric acid brought about any action worth mentioning.

(6) The product of grain and straw was increased in about equal degrees by the artificial manuring.

(7) The proportion of corn to straw was by thick sowing, on the average 47 to 53 or 1 to 1.13; by thin sowing, 45 to 55 or 1 to 1.22.

(8) The harvest showed throughout a tolerably low percentage of nitrogen, in the case of the straw; not, however, an extremely low one, plainly because the rooting up of the weeds and the strengthening of the stems of the oat plant by drilling and harrowing produced plants which were, on the average, poor in nitrogen.

(9) By thin sowing the plants were somewhat richer in nitrogen than by thick.

(10) The application of phosphoric acid alone was not able to raise the percentage of nitrogen.

(11) On the contrary, the percentage of nitrogen was essentially raised by the application of nitrogenous manures.

(12) An application of phosphate manures, together with that of nitrogenous manures, did not alter the percentage of nitrogen.

(13) The greater the harvest the greater also was the percentage of nitrogen in the grain and the straw; from this it appears that the more that was harvested, the better was the quality of the product. A rational method of manuring brings about, not alone greater crops, but also better grain.

(14) The small and poorly-shaped grain harvested with the application of large amounts of nitrogen, and in consequence of this somewhat stalled, possess a higher percentage of nitrogen than the fully-developed grain; they cannot, therefore, be looked upon as of less value.

(15) By an application of phosphate manure alone the percentage of oil in the grain was not increased.

(16) On the contrary, by an application of nitrogenous manure alone the oil was decreased.

(17) A weak application of phosphoric acid at the same time with one of nitrogen reproduced the original amount of oil; a stronger application of phosphate even increased it, plainly through assistance in ripening.

(18) The grain manured more strongly with nitrogen was on the whole somewhat richer in fiber and somewhat poorer in nitrogen free nutrients than the grain manured less with nitrogen and more with phosphoric acid.

(19) By a rational method of manuring the albuminoid content of the crop can be almost doubled.

(20) In these experiments 55 per cent. of the nitrogen applied in the manures was recovered in the crop.

In his report on the work of the experiment station in 1884, Dr. Maercker continues, in regard to the investigations:

During this year the same experiments have been carried out (with oats) again. It is the second year of which I here give an account, and the results of the first year are completely confirmed:

(1) That plants relatively poor in nitrogen have been obtained by drilling and harrowing.

(2) That thin sowing has in no case produced as much as thicker sowing.

(3) That a nitrogenous manuring raises strongly the percentage of nitrogen in oats. Further that in this year it has been found that, by manuring with phosphoric acid, the albuminoids were materially decreased, although the formation of starch has been

increased. Phosphoric acid hastens the ripening and in general the tendency of the plants to fill out the kernels completely, on which account there is more starch and less protein. Plants relatively poor in nitrogen are therefore produced.

The availability of plant-food is therefore the prime cause of there being so many variations in any one locality corresponding to the soil and manuring on which the crops are dependent.

Our analyses of oats extend over only one year, but Dr. Maercker in two has shown, as our work has with wheat, that "oats appear to be extraordinarily dependent, even in the same locality, in their composition, on the climatic conditions ruling during the opening period." The crops raised in 1882 and 1883, in exactly the same manner, compared in albuminoids, are as follows:

	Per cent.
Unmanured, 1882	7.8
Unmanured, 1883	10.2
600 pounds per acre of Chili saltpeter, 1882	10.5
600 pounds per acre of Chili saltpeter, 1883	12.8

The difference between these figures for the same year illustrates the effect of nitrogenous fertilizers on the percentage of that element in the grain, it being greater in the manured grain by 2.7 per cent. in 1882 and 2.6 per cent. in 1883; and at the same time the effect of the variation in the seasons is as markedly visible.

Comparing the production per acre with the percentage of nitrogen on the grain it was found that those varieties giving the largest yield were poorest in nitrogen, and the reverse.

No.	Name.	Pounds per acre.	Albuminoids.
			Per cent.
1	Anderbecker	3,737	8.7
2	Danish	3,591	8.5
3	Original Probsteier	3,564	9.3
4	Lüneburger clay	3,496	9.8
5	Hallet's Canadian	3,393	11.7
6	Australian	3,005	11.2
7	Hopetown	3,044	12.2
8	Black Californian	2,928	9.8
9	White Tartarian Swedish	2,874	10.1
10	Kylberg pedigree	2,839	9.5

These results, calculated to the amount of nitrogen harvested per acre by the whole plant, explain the differences by showing that all varieties collect about the same amount; consequently, if there is much grain the nitrogen is divided up among it, or if there is much straw the grain is thereby deprived of a certain amount. In 1883 the results were quite different from this. High yields had high percentages of nitrogen, as appears from conclusion 13, previously given. This point, therefore, hardly seems to be entirely settled, but to be largely dependent on the climatic conditions of varying seasons.

For more complete details, reference must be made to the original report upon the experiments, which are models of what should be undertaken in our own country. It is of interest, however, to copy cer-

tain tables which are of value for comparison with our own analyses and for filling out our knowledge of the plant in directions towards which our investigations did not extend.

EFFECT OF THICK AND THIN SOWING.

The following tables give the chemical composition of the grain harvested after thick and thin sowing. The average weight per bushel in both cases was 36.7 lbs. All the analyses are calculated to 15 per cent. of water, and the units of nutritive value, being calculated on a German basis, are to us of only relative value.

Composition of crops.

GRAIN.

[Thick sowing, 44 kilograms per hectare.]

Manuring.	No.	Ash.	Oil.	Carbhydrates.	Crude fiber.	Albuminoids.	Units of nutritive value.
Unmanured	1	3.1	3.8	60.0	10.4	7.7	118.0
— kilograms Chili saltpeter, 200 kilograms superphosphate	2	3.7	3.9	58.7	10.0	8.7	121.7
— kilograms Chili saltpeter, 400 kilograms superphosphate	3	3.2	3.9	59.4	10.5	8.0	110.9
200 kilograms Chili saltpeter, — kilograms superphosphate	4	3.3	3.1	58.7	10.6	9.3	120.7
300 kilograms Chili saltpeter, — kilograms superphosphate	5	3.1	3.0	59.2	9.8	9.9	124.2
400 kilograms Chili saltpeter, — kilograms superphosphate	6	3.0	2.9	58.2	10.4	10.5	125.2
200 kilograms Chili saltpeter, 200 kilograms superphosphate	7	3.1	3.5	59.7	9.4	9.3	123.7
300 kilograms Chili saltpeter, 200 kilograms superphosphate	8	3.2	3.4	58.6	10.2	9.6	123.6
400 kilograms Chili saltpeter, 200 kilograms superphosphate	9	3.1	3.5	56.9	11.1	10.4	126.4
200 kilograms Chili saltpeter, 400 kilograms superphosphate	10	3.0	4.3	58.9	8.6	10.2	131.4
300 kilograms Chili saltpeter, 400 kilograms superphosphate	11	3.0	4.3	58.2	9.3	10.2	130.7
400 kilograms Chili saltpeter, 400 kilograms superphosphate	12	3.5	4.2	56.4	11.0	9.8	126.4

[Thin sowing, 76 kilograms per hectare.]

Unmanured	13	3.3	3.8	59.6	10.4	7.9	118.1
— kilograms Chili saltpeter, 400 kilograms superphosphate	14	3.1	4.0	60.0	10.4	7.5	117.5
400 kilograms Chili saltpeter, — kilograms superphosphate	15	3.3	3.1	58.8	9.9	9.9	123.8
200 kilograms Chili saltpeter, 200 kilograms superphosphate	16	3.1	3.7	59.7	9.2	9.3	124.7
400 kilograms Chili saltpeter, 200 kilograms superphosphate	17	3.1	3.7	58.0	9.9	10.3	128.0
400 kilograms Chili saltpeter, 400 kilograms superphosphate	18	3.1	3.6	59.3	9.6	9.4	124.3

CHAFF.

[Thick sowing, 44 kilograms per hectare.]

Unmanured	1	13.9	.....	41.9	24.9	4.3	63.4
— kilograms Chili saltpeter, 200 kilograms superphosphate	2	14.1	.....	41.7	24.4	4.8	65.7
— kilograms Chili saltpeter, 400 kilograms superphosphate	3	14.0	.....	41.8	24.9	4.3	63.3
200 kilograms Chili saltpeter, — kilograms superphosphate	4	14.3	.....	42.2	23.7	4.8	66.2
300 kilograms Chili saltpeter, — kilograms superphosphate	5	13.6	.....	41.3	24.9	5.2	67.3
400 kilograms Chili saltpeter, — kilograms superphosphate	6	15.0	.....	40.7	24.0	5.3	67.2
200 kilograms Chili saltpeter, 200 kilograms superphosphate	7	13.0	.....	42.8	23.9	5.3	69.3
300 kilograms Chili saltpeter, 200 kilograms superphosphate	8	13.7	.....	41.8	24.1	5.4	68.8
400 kilograms Chili saltpeter, 200 kilograms superphosphate	9	15.1	.....	40.4	23.6	5.9	69.9
200 kilograms Chili saltpeter, 400 kilograms superphosphate	10	14.6	.....	41.8	23.6	5.0	66.8
300 kilograms Chili saltpeter, 400 kilograms superphosphate	11	14.2	.....	41.9	23.9	5.0	66.9
400 kilograms Chili saltpeter, 400 kilograms superphosphate	12	13.9	.....	42.3	23.1	5.7	70.8

[Thin sowing, 76 kilograms per hectare.]

Unmanured	13	13.8	.....	43.2	23.5	4.5	65.7
— kilograms Chili saltpeter, 400 kilograms superphosphate	14	14.1	.....	42.1	23.9	4.9	66.6
400 kilograms Chili saltpeter, — kilograms superphosphate	15	13.9	.....	41.6	24.2	5.3	68.8
200 kilograms Chili saltpeter, 200 kilograms superphosphate	16	13.1	.....	43.8	23.5	4.6	65.8
400 kilograms Chili saltpeter, 200 kilograms superphosphate	17	14.2	.....	42.4	24.0	4.4	64.4
400 kilograms Chili saltpeter, 400 kilograms superphosphate	18	14.4	.....	41.4	24.8	4.4	63.4

[Kilo. per hectare + .8923 = lbs per acre.]

Composition of crops—Continued.

STRAW.

[Thick sowing, 44 kilograms per hectare.]

Manured.	No.	Ash.	Oil.	Carbhydrates.	Crude fiber.	Albuminoids.	Units of nutritive value.
Unmanured	1	5.7	.....	38 6	38.9	1 83	48.1
— kilograms Chili saltpeter, 200 kilograms superphosphate	2	5.9	.....	36.9	40.5	1.66	45.4
— kilograms Chili saltpeter, 400 kilograms superphosphate	3	5.8	....	39.2	39.5	1.51	46.7
200 kilograms Chili saltpeter, — kilograms superphosphate	4	5.9	.....	39.3	38.2	1.55	47.3
300 kilograms Chili saltpeter, — kilograms superphosphate	5	6.2	....	37.7	39.5	1.62	45.7
400 kilograms Chili saltpeter, —0 kilograms superphosphate	6	6.2	.....	33.7	43.2	1.86	43.2
200 kilograms Chili saltpeter, 200 kilograms superphosphate	7	5.8	.....	37.9	39.7	1.62	45.9
300 kilograms Chili saltpeter, 200 kilograms superphosphate	8	6.4	.....	37.1	39.8	1.71	45.6
400 kilograms Chili saltpeter, 200 kilograms superphosphate	9	6.1	.....	37.4	39.5	2.04	47.4
200 kilograms Chili saltpeter, 400 kilograms superphosphate	10	5.9	.....	36.4	41.2	1.51	43.9
300 kilograms Chili saltpeter, 400 kilograms superphosphate	11	5.7	....	36.0	41.9	1.36	43.0
400 kilograms Chili saltpeter, 400 kilograms superphosphate	12	5.9	....	38.4	39.2	1.69	46.9

[Thin sowing, 76 kilograms per hectare.]

Unmanured	13	5.5	.....	38.1	40.1	1.27	44.6
— kilograms Chili saltpeter, 400 kilograms superphosphate	14	5.3	.....	39.0	39.5	1.24	45.2
400 kilograms Chili saltpeter, — kilograms superphosphate	15	5.4	.....	37.7	40.4	1.49	45.2
200 kilograms Chili saltpeter, 200 kilograms superphosphate	16	5.2	.....	38.2	40.3	1.27	44.7
400 kilograms Chili saltpeter, 200 kilograms superphosphate	17	5.5	.....	39.0	38.9	1.63	47.0
400 kilograms Chili saltpeter, 400 kilograms superphosphate	18	5.6	.....	37.9	40.0	1.46	45.4

COMPOSITION OF THE GRAIN.

	Thin sowing.			Thick sowing.			By Julius Kühn.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
Ash	3.7	3.0	3.2	3.3	3.1	3.2	2.7	2.7	2.7
Oil	4.3	2.9	3.7	4.0	3.1	3.7	9.2	4.4	6.0
Carbhydrates	60.0	56.4	58.6	60.0	58.0	59.3	72.7	48.0	56.6
Crude fiber	11.1	8.6	10.1	10.4	9.2	9.9	16.1	4.1	9.0
Albuminoids	10.5	7.7	9.5	10.3	7.5	9.0	18.5	6.3	12.0

COMPOSITION OF THE CHAFF.

Ash	15.1	13.0	14.1	13.1	13.1	13.9	11.0	11.0	11.0
Oil									
Carbhydrates	42.8	40.4	41.7	43.8	41.4	42.5	43.2	28.2	37.4
Crude fiber	24.9	23.1	24.1	24.8	23.5	24.0	35.1	25.9	31.7
Albuminoids	5.9	4.3	5.1	5.3	4.4	4.6	7.0	3.7	4.9

COMPOSITION OF THE STRAW.

Ash	6.2	5.7	6.0	5.6	5.2	5.4	4.4	4.4	4.4
Carbhydrates	89.2	33.7	37.3	39.0	37.9	38.3	48.9	24.9	35.6
Crude fiber	43.2	38.9	40.1	40.4	38.9	39.9	50.2	30.0	39.7
Albuminoids	2.0	1.4	1.7	1.6	1.2	1.4	7.0	1.3	4.0

All these results show how variable the oat plant is both for the same year and for different seasons, and that conclusions drawn from the studies of specimens of one season's growth alone may be quite reversed by a wider examination.

Many causes, however, influencing the variations in quality have been explained and the field for future investigation made evident.

RYE.

Of this cereal, which is of the least importance of any grown in the United States, only 5 samples have been analyzed up to the present time. To supply this deficiency, 56 specimens were collected from the Department correspondents and the principal rye-producing States, at the same time with those of oats and barley.

Their sources were as follows:

State.	No.	Name.	Sown.	Harvested.	County.	Town.	Sender.	Remarks.
Colorado	5021	Unknown	Sept. 1 to Oct. 20	July 10 to 20	Custer	Wetmore	J. W. Coleman	
Connecticut	5024	Common	Sept. to Oct	July 1 to 10	New Haven	South Britain	W. L. Mitchell	
	5027	....do	Sept. 20	July 20	New London	Groton	J. J. Cupp	
	5028	Common White	....do	July 22	Litchfield	West Coruwall	T. S. Gold	
	5029	Winter	Sept. 1 to Oct. 15	July 5 to 20	Fairfield	Green's Farms	W. J. Jennings	
Georgia	5052	Georgia	Sept. 1 to Dec. 1	May 15	Brooke	Quitman	J. G. McCall	
Illinois	5060	(?)	End of Sept	July	Will	Crete	J. O. Piepenhrink	
	5062	White	Sept. 10 to Oct. 20	July 20 to 25	Jo Daviess	Howardsville	A. M. Durkee	Seed from Department.
	5063	Common Winter	Sept. 1 to 15	July 1 to 15	Ogle	Baileyville	W. B. Derrick	
	5066	Common	Sept. 10	July 4	Livingstone	Cayuga	E. W. Pearson	
	5067	White Winter	Sept. 15 to Oct. 20	July 1	Lee	Dixon	Abram Brown	
	5068	Common Black	Oct. 1	....do	La Salle	Tooica	L. A. Burgess	
	5070	Winter	Sept. 1 to 25	July 5	Kankakee	Momence	A. L. Miner	
	5075	.....do	Nov. 1	June 10	Du Page	Downer's Grove	H. L. Bush	
	5079	Common White	Sept	July 1	Bureau	Princeton	D. Knight	
Indiana	5086	Spring	Apr. 10	July 25	Elkhart	Goshen	P. F. Nye	
Iowa	5094	Common	Sept. 20 to Oct. 10	June 25 to July 1	Taylor	Conway	J. L. Herr	
	5097	Summer Hill	Sept. 20 to 30	July 1 to 15	Sac	Wall Lake	J. H. Hoehing	
	5107	White Winter	Mid. Sept. to mid. Oct.	July 10	Clinton	Bryant	Dan. Conrad	
	5445				Lyon	Larchwood	Larchwood estate	
Kentucky	5116	White	Oct. 1 to 31	June 15 to 30	Lawrence	Louise	J. M. Clayton	
	5116[b]	Black	....do	...do				
Maryland	5140	(?)	Oct. 1 to 10	July 15 to 20	Frederick	Frederick	H. C. Brown	
	5141	Early White	Sept. to Oct	July 1	Garrett	Oakland	P. Hamill	
Minnesota	5163		Oct. 6	July 27	Todd	Long Prairie	L. S. Hoadley	
	5168	Canada White	Aug. 28	Aug. 4	Anoka	Anoka	A. Small	
	5179	(?)	(?)	(?)	Fillmore	Fillmore	G. W. Knight	
Missouri	5188	White	Sept. to Oct	June 15 to 25	Atchison	Langdon	R. Buckhein	
Nebraska	5198	Common, mixed	Sept	July 1	Antelope	Neligh	F. H. Trowbridge	
New Jersey	5214	Common White	Sept	June 20 to 25	Somerset	Blawenburg	D. C. Vorhees	
	5215	Jersey	Sept 15 to Oct. 15	July 10	Morris	Morristown	J. R. Runyan	
New York	5223	Winter	Sept. 1 to 10	July 4 to 15	Rensselaer	(?)	W. P. Rowe	
	5225	..... do	Sept. 10	July 6	Albany	Slingerland's	C. L. G. Blessing	
	5231	Native	Sep. 1 to 20	July 10	Dutchess	Mount Ross	Benjamin Wilbur	
	5234	White	Aug. 20 to Sept. 10	July 15 to Aug. 1	Saratoga	Greenfield Centre	B. S. Robinson	
	5235	Common	Sept	First of July	Schoharie	Schoharie	I. C. Van Tuyl	
North Carolina	5248	White	Sept. to Oct	July 1	Henderson	Hendersonville	Joseph Livingstone	
	5250	..... do	Sept	June to July	Ashe	Beaver Creek	J. F. Taylor	
Ohio	5260	Common	Sept. 1 to 20	June 1 to 15	Butler	Gano	Joseph Allen	
	5269	Black Fall	Oct. 18	July 1	Wood	Mermill	Andrew Welton	
Pennsylvania	5282	White	Sept. to Oct.	July 1	Union	Lewisburg	J. A. Gundy	Raised for straw.
	5286	Common	Sept. 18 to Oct	July 10	Butler	Butler	H. I. Berg	
	5286[b]	Canada						From Department in 1882.
Rhode Island	5290	Winter	Oct. 1	July	Washington	Wickford	B. H. Lawton	
South Carolina	5299	Common	Aug	May	Laurens	Goodgion's Fact'y	J. S. Wolff	

Sources of rye—Continued.

State.	No.	Name.	Sown.	Harvested.	County.	Town.	Sender.	Remarks.
Vermont	5322	Common New England			Bennington	Manchester	G. G. Burton	
	5323	White winter	Sept. 4		Windsor	Pomfret	Crosby Miller	
	5324	Winter	Sept. 18 to Nov	July 20 to Aug 20	Washington	Montpelier	A. D. Arens	
Virginia	5334	do	Last of Sept to Oct. 15.	Last June to July	Floyd	Floyd Court-House	Benjamin Phlegcr	
Washington	5341	Department	Oct	July 20	Skagit	Lyman	L. Everett	
West Virginia	5346	Peonsylvania White	Aug. 15 to Nov. 1	June 25 to July 10	Ohio	Rouy's Point	T. J. Orr	Poor on account of drought.
	5348	White	Oct. 15 to 20	July 1 to 4	Greenbrier	Lewisburg	H. Haudly	
Wisconsin	5351	Common	Apr. 1	Aug. 1	Chippewa	Eagle Point	John Bates	
	5353							
	5357	(?)	(?)	(?)	Lafayette	Fayette	S. E. Roberts	
	5360	Black Winter	Sept. 10	July 12	Fond du Lac	Metomen	E. Reynolds	
	5361	White	Oct. 1	(?)	Dodge	Burnett	H. Sawyer	Little grown here.

The specimens previously described have been examined physically and chemically with the following results:

Weight of 100 *grains and per bushel of American ryes.*

State.	Serial number.	Weight of 100 grains.	Weight per bushel.	State.	Serial number.	Weight of 100 grains.	Weight per bushel.
Vermont	5322	2.100	62.3	Illinois	5070	1.640	58.1
	5323	2.400	64.1		5075	1.840	59.4
	5324	2.100	58.6		5079	1.670	60.1
Connecticut	5024	2.410	.....	Wisconsin	5351	2.000	60.4
	5027	1.990	60.2		5353	2.100	62.6
	5028	2.380	61.5		5357	1.690	60.6
	5029	2.520	62.8		5360	1.850	60.2
Rhode Island	5290	2.150	.....		5361	2.700	61.9
New York	5223	2.240	60.4	Minnesota	5167	2.130	60.8
	5225	2.320	56.2		5168	2.780	62.2
	5231	2.310	60.1		5179	1.900	.....
	5234	2.160	62.6	Iowa	5094	1.590	60.2
	5235	2.060	63.1		5097	1.300	58.2
New Jersey	5214	1.700	63.3		5107	2.100	60.2
	5215	2.600	59.1	Nebraska	5198	1.300	60.3
Pennsylvania	5282	2.420	59.3	Maryland	5140	2.170	62.0
	5286	2.810	62.3		5141	2.570	59.9
	5286[2]	2.590	63.5	Virginia	5334	1.920	60.2
Ohio	5260	2.179	61.6	West Virginia	5346	2.430	62.8
	5269	2.080	61.7		5348	2.060	59.4
Indiana	5086	2.100	63.5	North Carolina	5248	1.870	62.1
Illinois	5060	1.910	60.4		5250	1.670	62.3
	5062	1.870	60.7	South Carolina	5299	2.040	.....
	5063	1.720	61.7	Kentucky	5116	1.580	.....
	5066	1.410	57.8		5116[2]	2.250	.....
	5067	2.100	60.0	Colorado	5021	1.810	61.4
	5068	1.820	58.7	Georgia	5052	1.240	.....
				Washington Ter.	5341	3.450	.....

Average weight per bushel and of 100 *grains of American ryes.*

State.	Number of determinations.	Weight of 100 grains.	Weight per bushel.	State.	Number of determinations.	Weight of 100 grains.	Weight per bushel.
United States	56	2.074	60.9	Wisconsin	5	2.070	61.1
Atlantic Slope	25	2.189	61.2	Minnesota	3	2.270	61.5
Northern States	43	2.074	60.8	Iowa	3	1.660	59.5
Southern States	11	1.981	61.2	Missouri	1	.....	62.6
Western States	25	1.745	60.0	Nebraska	1	1.300	60.3
Pacific Slope	2	2.030	61.4	Maryland	2	2.370	61.0
Vermont	3	2.200	61.7	Virginia	1	1.920	60.1
Connecticut	4	2.320	61.5	West Virginia	2	2.250	61.1
Rhode Island	1	2.150	.....	North Carolina	2	1.770	62.2
New York	5	2.220	60.5	South Carolina	1	2.040	.....
New Jersey	2	2.150	61.2	Kentucky	2	1.920	.....
Pennsylvania	3	2.610	61.7	Georgia	1	1.240	.....
Ohio	2	2.130	61.7	Colorado	1	1.810	61.4
Indiana	1	2.100	63.5	Washington Ter.	1	3.450	.....
Illinois	9	1.780	59.7				

Composition of American ryes, arranged by States.

State.	Serial number.	Water.	Ash.	Oil.	Carb-hydrates.	Fiber.	Albuminoids.	Nitrogen.
Vermont	5322	7.80	1.68	2.00	76.84	1.35	10.33	1.65
	5323	8.07	1.85	2.12	75.03	1.38	11.55	1.85
	5324	8.90	1.60	1.80	75.32	1.35	11.03	1.76
Connecticut	5024	8.84	2.00	1.91	75.02	1.38	10.85	1.74
	5027	7.74	2.20	2.09	75.72	1.75	10.50	1.68
	5028	9.17	1.97	1.74	75.55	1.32	10.25	1.62
	5029	9.69	1.88	1.80	75.38	1.45	9.80	1.57
Rhode Island	5290	9.75	2.10	1.71	74.40	1.89	10.15	1.62
New York	5223	3.02	2.55	2.09	71.43	1.38	14.53	2.32
	5225	9.12	2.40	1.58	74.96	1.26	10.68	1.71
	5231	8.98	2.16	1.69	74.37	1.25	11.55	1.85
	5234	8.93	1.77	2.10	76.42	1.33	9.45	1.51
	5235	7.35	2.16	2.13	75.37	1.61	11.38	1.82
New Jersey	5214	9.05	2.10	2.16	75.61	1.10	9.98	1.60
	5215	8.93	2.03	1.74	74.34	1.23	11.73	1.88
Pennsylvania	5282	9.35	2.15	1.86	73.71	1.20	11.73	1.88
	5286	8.75	2.14	1.76	74.63	1.34	11.38	1.82
	5286	9.35	1.70	1.92	74.31	1.52	11.20	1.79
Ohio	5260	9.81	2.55	1.79	74.00	1.35	10.50	1.68
	5269	8.15	1.70	1.93	74.26	1.88	12.08	1.93
Indiana	5086	9.60	1.57	1.73	77.22	1.13	8.75	1.40
Illinois	5060	9.57	1.93	2.16	74.59	1.42	10.33	1.65
	5062	9.99	3.72	1.98	72.41	1.35	10.55	1.68
	5063	8.85	1.80	2.09	76.01	1.10	10 15	1.62
	5066	7.62	2.73	2.06	72.68	1.95	12.96	2.07
	5067	8.85	2.15	1.85	75.05	1.25	10.85	1.74
	5068	8.73	3.37	1.86	71.33	1.58	13.13	2.10
	5070	9.45	1.60	1.92	75.08	1.45	10.50	1.68
	5075	8.45	2.36	1.98	72.48	1.60	13.13	2.10
	5079	9.18	1.62	1.70	75.15	1.15	11.20	1.79
Wisconsin	5351	8.65	2.32	1.86	74.50	1.47	11.20	1.79
	5353	8.41	1.55	1.59	76.97	1.15	10.33	1.65
	5357	8.80	1.96	1.84	74.50	1.35	11.55	1.85
	5360	8.38	1.90	1.38	74.88	1.56	11.90	1.90
	5361	10.00	1.95	1.69	74.13	1.38	10.85	1.74
Minnesota	5167	9.13	1.94	1.63	74.70	1.40	11.20	1.79
	5168	8.75	1.85	1.94	74.38	1.18	11.90	1.90
	5179	7.25	2.40	2.46	73.51	1.95	12.43	1.99
Iowa	5094	7.69	1.98	2.16	75.81	1.68	10.68	1.71
	5097	8.50	2.80	2.48	73.32	1.53	11.38	1.82
	5107	8.32	2.08	1.93	75.01	1.28	11.38	1.82
Missouri	5188	7.27	1.93	2.19	75.82	1.59	11.20	1.79
Nebraska	5198	8.27	1.31	2.25	77.54	1.39	9.28	1.48
Maryland	5140	9.70	2.10	1.93	73.16	1.38	11.73	1.88
	5141	9.64	1.80	1.65	74.63	1.43	10.85	1.74
Virginia	5334	8.60	2.30	1.77	73.10	1.80	12.43	1.99
West Virginia	5346	8.87	2.67	1.90	73.70	1.31	11.55	1.85
	5348	8.35	2.68	1.75	73.60	1.54	12.08	1.93
North Carolina	5248	8.75	2.01	1.85	74.46	1.55	11.38	1.82
	5250	8.60	1.55	2.33	74.64	1.63	12.25	1.96
South Carolina	5299	8.44	1.76	1.73	76.01	1.56	10.50	1.68
Kentucky	5116[2]	.....	.....	2.27	.....	1.70	12.25	1.96
	5116	9.82	1.93	1.93	72.86	1.38	12.08	1.93
Georgia	5052	8.24	1.91	2.17	72.90	1.83	12.95	2.07
Colorado	3582	9.05	2.80	1.98	68.74	1.85	15.58	2.49
	3581	8.05	1.95	2.91	72.38	1.76	12.95	2.07
	5021	6.85	2.05	2.01	76.23	1.48	11.38	1.82
Washington Territory	5341	7.00	2.10	2.05	76.27	1.55	11.03	1.76

Average composition of American ryes, arranged by States.

State.	Number of analyses.	Water.	Ash.	Oil.	Carb-hydrates.	Fiber.	Albuminoids.	Nitrogen.
United States	57	8.67	2.09	1.94	74.52	1.46	11.32	1.81
Atlantic Slope	25	8.75	1.99	1.91	74.74	1.45	11.26	1.79
Northern States	43	8.73	2.08	1.92	74.74	1.43	11.10	1.79
Western States	25	8.71	2.12	1.94	74.62	1.44	11.17	1.79
Southern States	10	8.80	2.07	1.90	74.01	1.54	11.68	1.88
Pacific Slope	4	7.74	2.23	2.24	73.40	1.66	12.73	2.04
Vermont	3	8.26	1.71	1.97	75.73	1.36	10.97	1.75
Connecticut	4	8.86	2.01	1.88	75.44	1.48	10.33	1.65
Rhode Island	1	9.75	2.10	1.71	74.44	1.89	10.15	1.62
New York	5	8.48	2.21	1.92	74.51	1.36	11.52	1.84
New Jersey	2	8.99	2.06	1.95	74.98	1.16	10.86	1.74
Pennsylvania	3	9.15	1.99	1.85	74.22	1.35	11.44	1.83
Ohio	2	8.98	2.13	1.86	74.13	1.61	11.29	1.81
Indiana	1	9.60	1.57	1.73	77.22	1.13	8.75	1.40
Illinois	9	8.96	2.36	1.96	73.87	1.43	11.42	1.83
Wisconsin	5	8.85	1.94	1.67	74.99	1.38	11.17	1.79
Minnesota	3	8.36	2.06	2.01	74.20	1.51	11.84	1.89
Iowa	3	8.17	2.29	2.19	74.71	1.50	11.14	1.78
Missouri	1	7.27	1.93	2.19	75.82	1.59	11.20	1.79
Nebraska	1	8.27	1.31	2.25	77.54	1.35	9.28	1.48
Maryland	2	9.67	1.95	1.79	73.90	1.40	11.29	1.81
Virginia	1	8.60	2.30	1.77	73.10	1.80	12.43	1.99
West Virginia	2	8.61	2.67	1.83	73.65	1.42	11.82	1.89
North Carolina	2	8.17	1.78	2.09	74.55	1.59	11.82	1.89
South Carolina	1	8.44	1.76	1.73	76.01	1.56	10.50	1.68
Kentucky	1	9.82	1.93	1.93	72.86	1.38	12.08	1.93
Georgia	1	8.24	1.91	2.17	73.90	1.83	11.35	2.07
Colorado	3	7.98	2.24	2.30	72.45	1.70	13.20	2.13
Washington Territory	1	7.00	2.10	2.05	76.27	1.55	11.03	1.76

The largest specimen was from Washington Territory, weighing 3.450 grams, the next from Minnesota, weighing 2.780 per 100 grains, and the heaviest weight per bushel from Vermont, 64.1 pounds. The smallest were from Iowa and Nebraska, weighing 1.300 grams per hundred, and the lightest from New York, 56.2 pounds per bushel, the average for the country being 2.074 and 60.9. The largest and heaviest ryes were found on the Atlantic coast and in the Northern States. The Pacific slope was not well represented.

The average weight per bushel is much higher than is usually accepted for rye, but the specimens in hand certainly reached those figures perhaps being very clean or selected samples above the average production. Illinois, which in the last census year produced more of the crop than any State except New York, sends the smallest and the lightest average grain.

In chemical composition the following extremes were found:

	Highest.	State.	Lowest.	State.
	Per cent.		*Per cent.*	
Water	10.00	Wiscoosin	7.00	Washington Territory.
Ash	3.72	Illinois	1.31	Nebraska.
Oil	2.91	Colorado	1.38	Wiscoosin.
Carbhydrates	77.54	Nebraska	68.74	Colorado.
Crude fiber	1.90	Minnesota	1.10	Illinois.
Albumioids	15.58	Colorado	8.75	Indiana.

But 5 were below 10 per cent. of albuminoids, and all but 4 were below 13 per cent.

The grain cannot be said to be extremely variable. The averages for the country is here given, together with an average of 49 analyses of ryes from all sources given by Koenig:

	United States.	Koenig.
Water	8.67	15.06
Ash	2.09	1.89
Oil	1.94	1.79
Carbhydrates	74.52	67.81
Crude fiber	1.46	2.01
Albuminoids	11.32	11.52

The extremes of albuminoid in Koenig's analyses were 16.93 and 7.91 per cent., which is wider than among our specimens. The difference between our grain and that of the Continent appears in the greater moisture of the latter, as is to be expected, together with more ash and oil and less fiber. For different parts of the United States the averages are very nearly concordant, the only variation being the difference of half a per cent. albuminoids and a little more fiber in ten specimens from the South. The nitrogenous constituents are practically the same. This cereal is richer than corn in this element, and not quite so rich as wheat.

Rye cannot be considered as being very susceptible to climatic conditions; in fact, it will flourish where other cereals will not. It requires therefore no greater care in its improvement than the selection of the variety giving the largest yield, and careful cultivation.

BARLEY.

Of American barley, from any point of view, but little has been known hitherto. Until lately, only nine chemical anaylses have been made, and, as Professor Brewer remarks, these are too few in number for generalizations. Statistics show that we have not produced enough of the cereal to supply the demand, and that it is always necessary to import a large amount every year. A study, therefore, of the conditions which affect the production of barley in the United States, which portions produce the most valuable grain, and how the composition varies in different localities as the result of climate and general environment, will be of interest, as showing the possibilities and best localities for the extension of the growth of this cereal.

Before discussing the results of our examination of the numerous American specimens collected through our agents, it will be of interest to give abstracts of some investigations on the production of barley in certain portions of Germany and this country, showing the yield, weight, physical characters and composition, and the directions in which it is considered desirable that this grain should be developed.

Dr. Maercker, of Halle, in a report on "Barley Experiments with Seed from Various Sources," a copy of which he has been good enough to send us, says that the problem of the production of the best barley has become an important one in the last few years in the province of the Salle, which has heretofore produced the best quality, but recently has met with much ill luck. To the end of studying the conditions affecting this cereal and learning the physical and chemical characteristics of the best varieties, seed selected by a mixed jury from a large exhibition of barleys were devoted to the experiment, and distributed among the leading agriculturists of the province. The varieties were grown with different supplies of nitrogenous manures, all the seed having been judged extremely fine (hochfein), and found to possess the following characteristics:

	Albuminoids.	Mealy kernels.
	Per cent.	*Per cent.*
Slavonian	7.7	92
Mravian	7.7	90
Danish	7.7	90
Saalish	8.1	80

From the experiments it was found that in the matter of yield the higher was obtained with the larger supply of nitrogenous manure, but that the quality was somewhat injured thereby, as the percentage of albuminoids was considerably raised, as can be seen from the determinations which were made:

	Saalish.	Danish.	Moravian.	Slavonian.
Original seed	8.10	7.70	7.70	7.70
100 kilograms Chili saltpeter, per hectare	8.19	9.16	9.18	8.92
200 kilograms Chili saltpeter, per hectare	8.48	9.56	9.78	9.52

The quality or consistency of the original seed was found in most cases to be lowered; and although the Slowakisch barley was superior to the rest, three samples out of seventeen being extremely fine, three fine, and eight good, it was nevertheless apparent that although the quality of the seed is an essential factor in the quality of the harvest, it is not the only one, but that climate, soil, manuring, and cultivation are much more important and of greater influence. One can in no way expect that the production of barley can be improved by selected seed alone. Care in other directions and favorable climatic influences, over which we have no control, are necessary as well.

The heavy manuring of nitrogenous material, as has been said, injured the quality, and how much so in comparison with a light one can be seen by enumerating the number of experimental samples which were found to be below the mean in quality. Of 89 manured with 100 kilograms of Chili saltpeter per hectare, only 6 were below medium; of

78 having 200 kilograms per hectare, 16 were below medium. Nitrogenous manures are not, accordingly, to be considered advisable on barley.

As to the relation of percentage of albuminoids, weight per bushel, and consistency to the quality of the grain, Dr. Mäercker remarks:

For a long time the author has busied himself with the question whether the amount of albuminoids stood in any relation to the value of barley, and in many cases this question could be answered that with few exceptions a barley rich in albuminoids is of poor quality, while a low content of albuminoids in general was an expression of high quality. It is, of course, understood that exterior conditions, rain, moisture, &c., can injure their value and make the barleys of low albuminoids of less worth than others richer in nitrogen. In proof of this, the decisions of the judges and the testimony of the laboratory furnish all that is desired.

The albuminoids in the crop as given in the previous table were over 1 per cent. higher than in the seed, and the quality was adjudged correspondingly poorer, and the specimen considered to be the worst was found to have increased 2.08 per cent. over the seed. Comparing the decision of the judges with the percentages of albuminoids the following coincidence was found:

Specimens denominated—	Mean per cent. of albuminoids.
Extremely fine	8.09
Fine	8.67
Good	8.93
Medium	9.78
Under medium	10.24

From these figures it cannot be denied "that high content of albuminoids appears to be incompatible with high quality."

To the weight the judges paid little attention. The determinations showed no relation between quality and weight.

Weight per hectoliter in kilograms* of the seed was as follows:

	Per cent.
Slavonian	68.7
Moravian	70.8
Danish	69.0
Saalish	69.2

And of the crops in the mean:

	Saalish.	Danish.	Moravian.	Slavonian.
100 kilograms saltpeter	67.2	67.2	66.6	67.3
200 kilograms saltpeter	67.2	66.8	67.5	66.7
Mean	67.1	67.0	67.1	67.0
Less than seed	2.1	2.0	3.7	1.7

The weight of the crop is on the average less than the seed; but between the different varieties there is no difference in the mean weight, despite the fact that there is a difference in quality.

* Kilogram per hectoliter × .7752 = pounds per bushel.

In regard to the mealy consistency of the grain the following figures furnish an explanation:

Per cent. of mealy kernels.

	Saalish.	Danish.	Moravian	Slavonian.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Seed	80.0	90.0	90.0	92.0
100 kilograms saltpeter	62.4	70.1	68.7	77.5
200 kilograms saltpeter	64.9	65.9	66.8	64.7
Mean	63.7	68.0	67.8	71.1
Less than seed	16.3	22.0	22.2	20.9

The mealiness of the crop is much less than of the seed, which agrees again with the decision of the judges, who it may be remarked placed the greatest dependence on the consistency of the kernel in forming their opinion, and in other respects with the conclusions derived from other characteristics.

Among a collection of 50 barleys which were submitted with the experimental specimens already mentioned, there were found none worthy of mention except the crop of one gentleman who had used no nitrogen but heavy manuring with phosphoric acid. His barleys were graded as follows:

	Extra fine (*a*).	Extra fine (*b*).	Extra fine (*c*).	Extra fine (*d*).	Fine.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Albumen	8.8	7.9	7.7	8.4	8.2
Weight	70.0	69.1	68.1	70.3	67.3
Mealy	88.0	88.0	82.0	86.0	86.0

From the preceding experiments we learn that the characteristics of a first quality barley are its consistency, color, and its albuminoid percentage, the latter in fine barleys not exceeding 8.67.

Several other investigators in previous years have not found the average up to the standard which has been set by the judges just mentioned. The results of Reischauer* show that the barleys which he had in hand were somewhat richer in nitrogen than those of Mäercker.

In 100 parts of dry substance.

	Nitrogen.	N × 6.25 Albuminoids.	Ash.	Phosphoric acid.	Silica.	Iron oxide.	Lime.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Maximum	2.856	17.85	3.34	1.145	0.845	0.0694	0.151
Minimum	1.282	8.01	2.12	0.614	0.460	0.0019	0.043
Average	1.729	10.804	2.799	0.902	0.641	0.0200	0.068

*Zeitschrift für das gesamte Brauwesen, 353–363, Bied. Centralblatt 11, 42–43.

In 100 parts of dry substance—Continued.

Source of barley.	Nitrogen.	N × 6.25 Albuminoid.	Ash.	Phosphoric acid.
Austria	1.564	9.77	2.818	0.900
Bavaria	1.655	10.34	2.848	0.944
Wurtemberg	1.658	10.36	2.860	0.962
Hesse	1.750	10.93	2.923	1.019
Prussia	1.806	11.29	2.853	0.920
Sweden	2.121	12.36	2.515	0.841
Denmark	1.661	10.38	2.720	0.928
Russia	2.188	13.67	2.753	0.921
Alsace	1.699	10.62	2.802	0.880
France	1.769	11.05	2.936	0.897
Africa	1.833	11.46	2.730	0.781

Louis Marx has also examined a large number of barleys—four hundred—from various countries, extending over six years' crops. His results have furnished the following averages for the amount of albuminoids usually present:

Series.	Source.	Mean.
		Per cent.
First series	(1) Russia	12.76
	(2) Baden	12.38
	(3) Sweden	11.97
	(4) Danube Province	11.68
	(5) Brunswick	11.49
Second series	(6) North Germany. Potsdam, 12.21; Oderbruch, 11.93; Magdeburg, 11.28; Saal, 10.49.	11.21
	(7) Bavaria	10.76
	(8) Alsace	10.70
	(9) Hungary	10.62
Third series	(10) France. Champagne, 10.90; Bourgoigne, 10.86; Auvergne, 9.90	10.55
	(11) Hesse	10.43
	(12) Wurtemberg	10.38
	(13) Denmark	10.91
	(14) England	9.69
Fourth series	(15) Austria. Slavonia, 9.90; Moravia, 9.79; Bohemia 9.12	9.61

In Russia, as with wheats, barley was found to be rich in albuminoids, one reaching 16.00. Bohemia and England, both celebrated for their malt, furnished but few samples with over 10.00 per cent. Bavaria, with 68 samples, had only 6 over 12.00 per cent.

The thick-hulled barleys were as a whole poorer in nitrogen, the hull being, of course, poor in that element. There was found to be no relation between nitrogen and phosphoric acid.

Some analyses by Lunter of barleys of the crop of 1883, used in the experimental brewery at Munich, have been published lately in Biedermann's Centralblatt für Agrikulturchemie, without great comment.

He finds in the experimental field that continuous cultivation for years can be carried on without essential alteration of the quality.

Serial number.	Source of barley.	Dry substances. Nitrogen.	Albuminoids.	Phosphoric acid.	Starch.	Water.	Germinability.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	Erding	1.646	10.29	1.003	71.28	8.46	30.80
2	Unterfranken	1.806	11.29	0.931	59.62	17.84	88.60
3	Bayer Landegerstel	1.661	10.38	1.047	66.45	16.58	90.10
4	Franken	1.601	10.00	0.913	66.61	14.82	95.40
5	Freisinger Gerstel	1.623	11.14	0.951	65.84	12.28	80.15
6	Moosburgor	1.585	9.90	0.930	65.16	12.47	83.14
7	Langenbacher	1.680	10.50	0.935	65.82	12.67	90.00
8	Landshuter	1.722	10.76	1.034	64.18	13.26	89.20

These samples, in albuminoids, certainly do not attain the high standard of quality set by Maercker.

Of American barleys, the only investigation, in addition to nine analyses collected by Professor Brewer, is that of eleven specimens at the Brewers' Experiment Station in New York, in 1883 or 1884,* the results of which are here given in one hundred parts of dry substance:

Serial number.	Source.	Weight per bushel.	Water.	Dry substance.	Dry substance. Starch.	Albuminoid (N. × 6.25).	Ash.	Phosphoric acid.
		Lbs.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	Canada	50⅛	10.04	89.96	63.63	10.73	2.78	0.950
2	Iowa	48¾	9.22	90.78	59.48	11.18	3.16	1.149
3	Bald barley (Kansas)	57½	10.41	89.59	64.49	10.16	2.86	0.997
4	Western barley	48½	9.56	90.44	60.30	12.39	3.21	1.124
5	do	48½	9.36	90.64	61.36	11.36	3.31	1.278
6	Scotch barley (Waukesha County, Wis.)	48	10.21	89.79	59.54	8.18	3.77	1.582
7	New York State	.....	12.05	87.95	66.31	12.79	2.59	.....
8	California	54	12.40	87.60	66.54	13.60	2.45	.....
9	Wisconsin barley	48½	11.89	88.11	65.98	10.27	2.84	1.000
10	Wiscousin barley (Farmer barley)	47	11.56	88.44	66.29	12.23	2.96	1.030
11	New York State	50	14.06	85.94	63.70	11.62	2.51	.....
	Mean	50⅛	10.96	89.04	63.42	11.32	2.95	1.139

The investigation proves principally that the weight per bushel is hardly a safe guide as to quality, but one must rather judge from the percentage of moisture and nitrogenous constituents which the grain contains. The specimens examined were certainly not extremely starchy, nor were they very dry. Being so few in number, they hardly form a basis for rational conclusion in regard to our grain and its comparison with that of other countries, but they were considered by the editor of the Prag. Agricultural Journal as showing that American barleys were quite equal to those of the Continent.

* Bied. Centbl. j. Agrikchemie 13, 491–2.

The results which have been quoted, while showing that the standard to be reached if possible is a large mealy grain with not more than 8 per cent. of albuminoids as described by Maercker, seem to prove rather conclusively that little barely of this quality is produced on the Continent or elsewhere. The best ranges in the neighborhood of 9.5 per cent. and from 10 to 11 is a fair average.

The sixty samples from all parts of the United States and twelve from Canada, collected for the present investigation, will, when examined in connection with the previous results at home and abroad, give us a reasonable basis for deciding as to our shortcomings and peculiarities.

AMERICAN BARLEY.

The samples of American barley have been collected through our agents from those parts of the country where it is a crop of prominence. They represent fairly well the production of the United States. The largest number of analyses are not for the largest areas of production—New York, Wisconsin, and California, which raise more than half the crop—but they are scattered through all the States where any amount of barley is grown. In considering the average features of the crop as it is found in market, regard must be had especially for the figures for Canada and the three States named, although the California barley never reaches our Eastern markets.

The other cereals have been analyzed free from any hulls or chaff. It would have been of interest for comparison to have been able to separate the barleys in the same way. Owing to the close adherence this is very difficult, but in a few cases it was attempted and the analyses of these specimens are given, together with a few of the naked varieties.

The sources of the barleys are described in the following tables.

Sources of specimens of barley.

State.	Serial number.	Name.	When sown.	When reaped.	County.	Post-office.	Sender.	Remarks.
California	4015	Coast	Feb. 1	June 1	Ventura	New Jerusalem	M. McLaughlin	
	4016	Six-rowed	Feb. to Mar	July	Contra Costa	Martinez	J. Strentzel	Brown.
Connecticut	4028	Two-rowed	Apr. 28	Aug. 4 to 8	Litchfield	West Cornwall	T. S. Gold	
Dakota	4030	Common	May 5	July 20	Stutsman	Jamestown	J. S. Nichols	
	4035	Chevalier	May 3	July 25	Cass	Fargo	W. H. Leverett	Brown.
	4036	Four-rowed	Apr. 5	July 10	Bon Homme	Tyndall	A. Zienert	Seed from Department.
Illinois	4062	Common	Apr. 1 to 15	July 15 to 20	Stephenson	Howardsville	A. M. Durkee	Brown.
	4063	Common spring	Apr.	July 15	Ogle	Baileyville	W. B. Derrick	Not first quality.
	4065	Spring	Early April	do	McHenry	Crystal Lake	James Crow	Forty-eight bushels per acre.
	4067	Common	Mar. to Apr	July 1 to 15	Lee	Dixon	Abram Brown	White, mealy.
Indiana	4080	do	Sept. 10 to 20	June 10 to 20	Shelby	Morristown	W. W. Woodward	Do.
	4081	Early May	Last Aug. to Sept	June 1 to 15	Franklin	Mount Carmel	J. A. Applecite	
	4085	Do not know	Sept. to Oct. 15	Last of May	Spencer	Rockport	James Lane	
	4090							
Iowa	4091	Scotch	Apr. 1	July 4	Scott	Davenport	H. C. Fulton	
	4097	Quinlan	Mar 25 to Apr. 10	July 25 to Aug. 10	Sac	Wall Lake	J. H. Hoebing	
	4098	Four-rowed	Apr. 10 to 15	July 15 to 20	Palo Alto	Ruthven	J. A. Anthony	
	4101	Common	Apr. 15	July 15	Winneshiek	Decorah	M. H. Merrill	Fifteen-year grown.
	4104	do	Apr	July 25	Fayette	West Union	B. F. Conkey	Brown.
	4107	Spring	Apr. 1 to 15	July 20	Clinton	Bryant	D. Conrad	Do.
Kentucky	4122	Canada	Sept. 26	June 20	Jefferson	Fern Creek	N. Cartwright	
Michigan	4151	Four-rowed	Apr. 10	July 15	Genesee	Flint	F. H. Raokin	
	4153	Six rowed	March 27	July 28	Livingston	Highland	J. D. Crouse	
	4156	Common	Apr. 21	Aug. 1	Ottawa	Berlin	C. W. Wilde	
	4158	Four-rowed	Apr. 26	July 28	Saint Clair	Jeddo	Moses Locke	
	4160	do	Apr. 20	July 25	Shiawassee	Corunna	S. R. Kelsey	Brown.
Minnesota	4163				Todd	Long Prairie	L. S Hoadley	
	4166	Spring	Middle May	Aug. 12	Otter Tail	Deer Creek	C. E. Mason	
	4169	Three-rowed	May 20	July 20	Dodge	Mantorville	Z. B. Page	
	4170	Scotch			Wioona	Minnesota City	O. M. Lord	
	4172	do	May 8	July 27	Dakota	Hastings	R. A. Simmons	Brown.
	4175	Four-rowed	Apr. 25	July 15	Blue Earth	Willow Creek	E. P. Wilder	
	4176	Scotch	Apr. 24	July 20	Olmsted	Marion	A. J. Goode	Bleached with rain.
	4179	do	May 5	Aug. 1	Fillmore	Fillmore	G. W. Knight	Browo.
Missouri	4188		Apr. 1 to 20	June 15 to 25	Atchison	Langdon	R. Buckham	Do.
Montana	4196	Common two-rowed	Apr. 15	Last of August	Meagher	Cantou	J. G. Pickering	
	4197	Two-rowed or English	May 1	Aug. 15	Gallatin	Bozoman	William Flannery	Do.
Nebraska	4198	Common six-rowed	Apr. 1	July 1 to 10	Antelope	Neleigh	F. H. Trowbridge	
Nevada	4202		Apr. 2	Aug. 14,	Esmeralda	Wellington	T. L. Smith	
	4205	Lincoln	Apr. 15	October	Douglas	Genoa	H. F. Dangberg	
New York	4220	(1)	(1)	(1)	Yates	Mile Centre	A. H. Ansley	
	4228	Five-rowed barley	June 3	Aug. 27	Allegany	Nile	Jesse D. Rogers	

Sources of specimens of barley—Continued.

State.	Serial number.	Name.	When sown.	When reaped.	County.	Post-office.	Sender.	Remarks.
New York	4232	Canada six rowed	May 1 to 15	July 1 to 15	Ontario	Naples	J. M. Anable	Mealy, white.
	4223	Canada two rowed	May 1	Aug. 8	Otsego	Cooperstown	G. P. Keese	
	4235	Imperial	May 1	Aug. 1	Schoharie	Schoharie	I. C. Van Tuyl	
	4243	Imperial six-rowed	Apr. 20	Aug. 1	Cayuga	Fleming	Howard Tryon	
	4426							
Ohio	4260	Early May	Sept. 10 to 25	June 1 to 10	Butler	Gano	Joseph Allen	Brown.
	4269	Fall	Oct. 8	June 26	Wood	Mermill	Andrew Welton	
	4271				Warren	Lebanon	D. P. Egbert	
Oregon	4275	Chevalier	Apr. 1	Aug. 15	Baker	Baker City	Thomas Smith	Brown.
	4277		Feb. to May	Aug. to Sept	Linn	Albany	G. F. Crawford	
	4423				Grant	Canyon City		
Pennsylvania	4285	Nohama	May 10	July 15	Crawford	Conneautville	R. Bolard	
South Carolina	4299	Four-rowed	October	Last of May	Laurens	Goodgion's Factory	J. S. Wolff	For early feed.
Utah	4319	Two-rowed	May 1	Sept. 1	Wasatch	Heber	John Crook	
Vermont	4323	Four-rowed	May 8	(?)	Windsor	Pomfret	Crosby Miller	
	4324	do	May 15 to July 1	Aug. 15 to Sept. 20	Washington	Montpelier	A. D. Arms	
	4326	Common	May 10	Aug. 15	Orleans	Irasburgh	Z. E. Jameson	
	4325							
Wisconsin	4351	Common	May 15	July 15	Chippewa	Eagle Point	John Bates	
	4353	(?)	(?)	(?)	Vernon	Viroqua	William Cox	Brown.
	4357	(?)	(?)		La Fayette	La Fayette	S. E. Roberts	Do.
	4360	Scotch Pearl	Apr. 17	July 27	Fond du Lac	Metomen	E. Reynolds	Do.
	4361	Mensury	May 1 to 5	July 25	Dodge	Burnett	H. Sawyer	Do.
Arizona	4364	Common	December	June	Pinal	Florence	W. E. Guild	
California	4374	(?)	(?)	(?)	Solano	(?)	H. Peters	
	4378	Common	Jan. to March	June to July	Monterey	Salinas	J. R. Leese	
	4382	(?)	Mar. 1	Late August	Humboldt	Eureka	Fred Axe	
Dakota	4390	(?)	(?)	(?)	Traill	Caledonia	P. Hebrandson	
	4391	(?)	(?)	(?)	Lawrence	Deadwood	J. Carney	
Michigan	4406	Common	May 10	Aug. 20	Cheboygan	Cheboygan	Jacob Walker	
Montana	4415	Two-rowed brewers	Apr. 15 to May 10	Aug. 15	Deer Lodge	Deer Lodge City	D. C. Irvine	
	4423	Bald	Apr. 18	July 30	Grant	John Day City	Joseph Magone	
	4423[2]	Common	do	do	do	do	do	
Washington	4435	Black Nepaul	Fall or spring	Early or late summer.	Pierce	Tacoma	L. E. Sampson	Brown.
Ohio	4444	Comm Fall	Sept. 1 to 15	June 1 to 20	Butler	Hamilton	G. K. Shaffer	
Iowa	4445	(?)			Lyon	Larchwood	J. B. Warren	

CANADIAN BARLEYS.

The specimens of Canadian barleys were obtained by application to Hon. A. Blue, of the Bureau of Agriculture and Arts, in Toronto. He forwarded them to the Department with the following letter:

I was not able until yesterday to get the samples of Ontario barley asked for by you for analysis. They were sent on by express, and I trust will reach you safely. The samples have been collected from four districts of the Province, and graded 1, 2, and 3 by the Government inspector here. The districts are indicated as A, B, C, and D, and the localities are shown on the inclosed map.

As a rule, our best barley is produced in the counties north of Lake Ontario, and especially in those bordering on the Bay of Quinte, viz, Prince Edward, Lennox, and Addington and Hastings; but this year it was injured there by rains at the harvest season.

The western district is much more subject to summer rains, owing to its situation between the Great Lakes, and the barley is often discolored.

The brightest grain this year is found in the counties of Peel, York, Ontario, and Durham.

I shall be greatly obliged if you will send me the results of your analysis.

The districts as indicated included—

A, the counties north of the central part of Lake Erie; B, the counties north of the northwestern part of Lake Ontario; C, the counties north of the central portion of Lake Ontario; D, the counties north of the northeastern portion of Lake Ontario, bordering on the Bay of Quinte.

B, C, and D are therefore the best barleys, and especially D, which was, however, unfortunately injured this year, and the brightest grain found in B.

How these practical opinions of quality agree with the facts learned from chemical analysis and with the investigations of Maercker will appear in our discussion of the results.

CHEMICAL AND PHYSICAL DATA.

In the following tables are arranged the data which have been obtained from an examination of the specimens which have been described, together with averages for the United States and Canada, and for the various States and geographical divisions:

Canadian barleys.

Grade.	Serial number.	District.	Composition.							Weight.		Consistency.			
			Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.	Weight per 100 grains.	Weight per bushel.	Mealy.	Half mealy.	Quarter mealy.	Little mealy.	Glassy.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. c.*	*Grms.*	*Lbs.*					
First quality	6041	A[1]	7.58	2.98	2.70	73.49	3.10	10.15	1.62	2.910	54.8	16	32	24	20	8
Do	6044	B[1]	8.35	2.73	2.69	73.23	3.55	9.45	1.51	3.069	56.1	..	48	36	12	4
Do	6047	C[1]	6.95	2.68	2.64	74.28	3.65	9.80	1.57	3.206	55.9	40	28	20	12	..
Do	6050	D[1]	8.35	2.88	2.67	73.13	3.69	9.28	1.48	3.445	52.7	12	36	36	16	..
Average	....	....	7.81	2.82	2.67	73.53	3.50	9.67	1.54	3.158	54.9	17	36	29	15	3
Second quality	6042	A[2]	7.85	2.95	2.72	72.76	3.22	10.50	1.68	2.818	54.5	36	40	12	12	..
Do	6045	B[2]	7.03	2.80	2.80	73.46	3.76	10.15	1.62	3.056	54.7	16	36	28	16	4
Do	6048	C[2]	10.08	1.62	2.78	72.58	3.49	9.45	1.51	2.934	53.5	12	36	32	20	..
Do	6051	D[2]	8.43	3.18	2.63	72.55	3.41	9.80	1.57	3.257	53.5	24	40	32	4	..
Average	....	....	8.35	2.64	2.73	72.84	3.47	9.97	1.59	3.021	54.1	22	38	26	13	1
Third quality	6043	A[3]	8.78	2.70	2.69	72.35	3.50	9.98	1.60	3.012	52.4	36	28	24	8	4
Do	6046	B[3]	6.75	2.83	2.72	73.87	3.68	10.15	1.62	3.094	54.8	16	44	32	..	8
Do	6049	C[3]	8.13	3.05	2.67	72.82	3.35	9.98	1.60	2.941	52.4	..	40	44	16	..
Do	6052	D[3]	7.93	3.18	2.74	73.47	3.35	9.33	1.49	3.226	54.3	20	32	24	20	4
Average	....	....	7.89	2.94	2.71	73.13	3.47	9.86	1.58	3.068	53.5	18	36	31	11	4
Average A locality	....	...	8.07	2.88	2.70	72.87	3.27	10.21	1.63	2.943	53.9	30	33	20	13	4
Average B locality	....	...	7.37	2.79	2.74	73.52	3.66	9.92	1.58	3.073	55.2	11	43	32	9	5
Average C locality	....	....	8.39	2.45	2.70	73.23	3.49	9.74	1.56	3.027	53.9	17	35	32	16	..
Average D locality	....	....	8.24	3.08	2.68	73.05	3.48	9.47	1.51	3.309	53.5	19	36	31	13	1
Grand average	....	....	8.02	2.80	2.70	73.17	3.48	9.83	1.57	3.088	54.1	19	37	29	13	2

Physical properties of barley.

Locality.	Serial No.	Weight of 100 grains.	Weight per bushel.	Mealy.	Half mealy.	Quarter mealy.	Little mealy.	Glassy.
Vermont	4323	3.120	52.2	.....	16	44	24	16
	4324	3.480	51.4	40	36	16	8	.....
	4326	2.980	52.4	.....	20	40	40	.....
Connecticut	4028	4.380	53.0	12	24	36	28	.....
New York	4220	3.390	57.7	.....	.....	.....	.....	.....
	4226	2.880	54.5	.....	.....	.....	.....	.....
	4228	3.300	51.4	.....	36	44	20	.....
	4232	3.570	53.4	16	28	28	28	.....
	4233	3.380	49.3	20	40	28	12	.....
	4235	.....	51.0	.....	.....	.....	.....	.....
	4243 I	3.410	54.7	8	24	24	44	.....
	4243II	2.690	52.0	.....	.....	.....	.....	.....
Pennsylvania	4285	2.630	50.4	8	36	24	32	.....
Ohio	4260	3.690	53.9	16	40	32	12	.....
	4269	3.170	50.8	36	36	20	8	.....
	4271	3.180	52.5	40	44	12	4	.....
	4444	2.980	51.0	40	32	20	8	.....
Michigan	4151	3.450	54.3	16	36	40	8	.....
	4153	2.280	49.3	.....	32	36	24	8
	4156	3.200	51.3	24	28	28	20	.....
	4158	3.260	56.8	4	36	44	16	.....
	4160	3.180	53.7	16	40	28	16	.....
	4406	3.530	58.7	24	32	28	16	.....
Indiana	4080	3.310	53.2	24	48	28	.....	.....
	4081	3.110	53.1	12	36	28	24	.....
	4085	3.570	54.3	48	22	16	14	.....
Illinois	4062	2.740	50.4	32	28	20	20	.....
	4063	2.840	49.8	28	32	32	8	.....
	4065	3.050	52.0	24	36	24	16	.....
	4066	2.880	.....	.....	.....	.....	.....	.....
	4067	2.920	52.2	12	28	24	36	.....

Physical properties of barleys—Continued.

Locality.	Seriel No.	Weight of 100 grains.	Weight per bushel.	Mealy.	Half mealy.	Quarter mealy.	Little mealy.	Glassy.
Wisconsin	4351	3.180	50.6	8	32	40	20	.....
	4353	3.360	50.6	36	32	32	.....	.....
	4357	2.950	48.5	36	24	24	16	.....
	4360	3.390	53.3	16	36	28	12	8
	4361	3.720	53.3	16	28	28	20	8
Minnesota	4163	3.610	.....	.....	.....	.....	.....	.....
	4166	3.503	56.2	12	44	32	12	.....
	4169	2.610	50.8	16	36	36	12	.....
	4170	3.520	52.8	24	44	28	4	.....
	4172	3.390	50.8	40	36	24	.....	.....
	4175	2.760	51.8	12	44	40	4	.....
	4176	3.220	51.8	28	36	28	8	.....
	4179	3.710	55 0	24	60	16	.....	.....
Iowa	4090	2.820	53.5	16	52	24	8	.....
	4091	3.130	52.6	16	36	28	20	.....
	4097	2.900	51.4	24	36	28	12	.....
	4098	3.010	51.3	20	36	28	16	.....
	4101	2.890	54.8	8	20	32	32	8
	4104	3.320	55.3	8	32	44	16	.....
	4107	3.140	54.1	24	24	36	16	.....
Missouri	4188	2.642	53.1	12	28	52	8	.....
Nebraska	4198	3.830	53.2	4	28	40	28	.....
Dakota	4030	3.370	54.3	8	40	36	16	.....
	4035	4.930	56.7	16	32	40	12	.....
	4036	2.780	53.0	20	36	32	8	4
	4090	2.720	52.0	16	52	24	8	.....
	4091	3.000	.....	16	36	28	20	.....
Montana	4196	3.950	58.6	.....	.....	.....	.....	.....
	4197	4.360	58.1	40	28	24	8	.....
	4415	4.350	57.4	76	24	.....	.....	.....
	4423	.....	67.9	.....	.....	.....	.....	.....
	4423[11]	.....	53.4	20	32	28	20	.....
South Carolina	4299	2.950	.....	.....	.....	.....	.....	.....
Kentucky	4122	3.366	.....	.....	.....	.....	.....	.....
Utah	4319	4.218	60.2	24	44	28	4	.....
Nevada	4202	4.290	55.1	.....	.....	.....	.....	.....
	4205	4.140	56.2	.....	.....	.....	.....	.....
Arizona	4364	4.180	53.2	20	44	28	8	.....
Washington Territory	4435	4.930	65.8	16	28	36	20	.....
Oregon	4275	4.490	59.9	.....	24	40	36	.....
	4277	5.110	52.2	24	36	40	.....	.....
California	4015	4.220	49.9	48	36	16	.....	.....
	4016	4.920	55.7	24	48	20	8	.....
	4374	4.550	53.5	24	52	24	.....	.....
	4378	5.180	.....	8	48	32	12	.....
	4382	5.630	.....	.....	.....	.....	.....	.....

Average physical properties of American barleys.

State.	No. of determinations.	Weight per 100 grains.	Weight per bushel.	Mealy.	Half mealy.	Quarter mealy.	Little mealy.	Glassy.
		Grams.	*Pounds.*					
United States	76	3.482	54.0	20	35	29	15	1
Canada	12	3.088	54.1	19	37	29	13	2
Eastern States	13	3.016	52.6	11	29	32	26	2
Western States	39	3.171	52.8	21	35	30	13	1
Northwestern States	10	3.680	57.2	27	35	26	11	1
Pacific Slope	12	4.655	56.8	21	40	29	10	0
Vermont	3	3.193	52.0	13	24	34	24	5
New York	8	3.217	53.1	11	32	31	26	0
Ohio	4	3.230	52.1	33	38	21	8	0
Michigan	6	3.150	54.0	14	34	34	16	1
Indiana	3	3.330	53.5	28	35	24	13	0
Illinois	5	2.890	51.1	28	32	25	15	0
Wisconsin	5	3.320	51.3	22	30	31	14	3
Minnesota	7	3.290	52.7	22	43	29	6	0
Iowa	7	3.030	53.4	17	34	32	16	1
Dakota	5	3.354	54.2	15	39	32	13	1
Montana	5	4.220	59.1	45	28	17	10	0
Nevada	2	4.215	55.7	.....	.....	.....	.....	0
Oregon	2	4.800	56.1	12	30	40	18	0
California	5	4.900	53.0	26	46	23	5	0

Composition of American barleys (unhulled), arranged by States.

State.	Serial No.	Water.	Ash.	Oil.	Carbohydrates.	Fiber.	Albuminoids.	Nitrogen.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Vermont	4323	6.70	2.22	2.90	70.28	3.90	14.00	2.24
	4324	6.50	2.40	2.65	72.37	3.48	12.60	2.02
	4326	6.55	2.90	2.75	71.57	4.15	12.08	1.93
Connecticut	4028	6.50	2.99	2.33	75.14	2.89	10.15	1.62
New York	4226	6.86	2.40	2.76	72.85	3.40	11.73	1.88
	4228	6.77	2.12	2.77	73.41	3.55	11.38	1.82
	4232	5.90	2.70	2.58	74.14	3.05	11.63	1.76
	4233	6.95	2.64	2.66	74.47	3.13	10.15	1.62
	4243	7.39	2.45	2.48	73.10	3.73	10.85	1.74
Pennsylvania	4275	6.27	3.05	2.06	72.89	3.83	11.90	1.90
Ohio	4260	6.85	3.30	3.53	71.84	3.80	10.68	1.71
	4269	6.25	3.07	2.40	73.13	4.65	10.50	1.68
	4271	6.81	3.55	2.58	72.91	4.00	10.15	1.62
	4444	6.80	3.10	2.06	73.92	4.32	9.80	1.57
Michigan	4151	6.44	2.97	2.70	71.33	3.43	13.13	2.10
	4153	6.37	2.59	2.73	69.73	3.88	14.70	2.35
	4158	6.73	2.56	2.90	71.83	3.03	12.95	2.07
	4160	5.27	3.05	2.71	73.36	3.71	11.90	1.90
	4406	6.55	2.75	2.55	75.45	3.07	9.63	1.54
Indiana	4080	5.99	3.50	3.54	71.19	4.40	11.38	1.82
	4085	5.92	2.95	2.73	75.37	3.58	9.45	1.51
Illinois	4062	5.06	3.34	2.61	70.88	4.51	12.60	2.02
	4063	6.18	3.16	2.59	72.55	4.14	11.38	1.82
	4065	6.72	2.73	2.81	72.15	2.64	12.95	2.07
	4067	6.52	3.08	2.66	71.77	3.37	12.60	2.02
Wisconsin	4351	7.15	2.90	2.76	70.51	4.43	12.25	1.96
	4353	7.40	2.30	2.74	73.17	3.83	10.50	1.68
	4357	6.60	3.60	2.65	72.03	4.27	10.85	1.74
	4360	7.70	2.75	2.50	72.77	3.78	10.50	1.68
	4361	6.40	3.15	2.49	70.88	3.95	13.13	2.10
Minnesota	4169	7.60	1.50	2.69	73.79	3.57	10.85	1.74
	4170	6.20	3.00	3.07	73.88	4.40	9.45	1.51
	4172	6.30	2.51	2.76	74.72	4.43	9.28	1.48
	4175	7.22	3.15	2.80	71.25	3.08	11.90	1.90
	4176	9.15	2.97	2.72	70.69	3.97	10.50	1.68
Iowa	4091	6.47	2.85	2.63	71.34	3.93	12.73	2.04
	4098	5.69	3.18	2.75	72.28	4.37	11.73	1.88
	4101	6.24	2.97	2.83	72.68	3.90	11.38	1.82
	4104	6.67	3.33	2.65	69.19	3.81	14.35	2.30
Nebraska	4198	7.58	3.00	2.70	71.12	3.35	12.25	1.96
Dakota	4030	5.80	3.05	3.01	69.97	3.29	14.88	2.38
	4035	5.55	2.90	2.46	74.19	3.35	11.55	1.85
	4036	5.75	3.13	2.94	71.02	3.68	13.48	2.16
	4390	6.00	3.20	2.74	72.23	3.75	12.08	1.93
	4391	5.95	2.65	2.68	71.34	4.25	13.13	2.10
Montana	4196	7.55	1.70	2.60	74.53	3.99	9.63	1.54
	4197	6.60	3.00	2.52	74.20	3.35	10.33	1.65
	4415	4.95	3.15	2.56	76.79	3.10	9.45	1.51
South Carolina	4299	6.85	2.65	2.45	73.62	4.10	10.33	1.65
Keotucky	4122	6.00	2.90	2.37	75.73	4.25	8.75	1.40
Utah	4319	7.70	3.40	2.53	72.99	2.88	10.50	1.68
Arizona	4364	6.26	2.90	2.63	74.30	4.28	9.63	1.54
Washington	4435	5.95	3.50	2.98	70.97	4.35	12.25	1.96
Oregon	4275	6.27	3.05	2.06	72.89	3.83	11.90	1.90
	4277	6.20	2.78	2.71	75.56	4.00	8.75	1.40
California	4016	6.70	2.74	3.01	74.32	4.14	9.10	1.46
	4374	4.53	4.43	2.72	74.74	4.48	9.10	1.46
	4378	6.18	2.74	2.50	75.52	4.13	8.93	1.43
Wyoming	4423	6.70	2.20	2.52	74.03	3.00	11.55	1.85
Colorado	3584	8.15	2.77	2.87	68.99	3.92	13.30	2.13

Average composition of American barleys (unhulled), arranged by States.

State.	Number of analyses.	Water.	Ash.	Oil.	Carbohydrates.	Fiber.	Albuminoids.	Nitrogen.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
United States	60	6.53	2.89	2.68	72.77	3.80	11.33	1.81
Atlantic Slope	10	6.64	2.51	2.59	73.02	3.57	11.59	1.85
Northern States	48	6.55	2.87	2.69	72.55	3.76	11.58	1.85
Western States	30	6.66	2.96	2.73	72.26	3.87	11.52	1.84
Northwestern States	8	6.02	2.85	2.69	73.03	3.59	11.82	.... ..
Pacific Slope	10	6.47	3.05	2.65	72.43	3.90	11.50	1.69
Vermont	3	6.58	2.51	2.77	71.41	3.84	12.89	2.06
Connecticut	1	6.50	2.99	2.33	75.14	2.89	10.15	1.62
New York	5	6.77	2.46	2.65	73.59	3.50	11.03	1.76
Pennsylvania	1	6.27	3.05	2.06	72.89	3 83	11.90	1.90
Ohio	4	6.68	3.25	2.64	72.95	4.19	10.28	1.64
Michigan	5	6.27	2.79	2.72	72.34	3.42	12.46	1.99
Indiana	2	5.95	3.23	3.13	73.28	3.99	10.42	1.67
Illinois	4	6.37	3.08	2.67	71.84	3.66	12.38	1.98
Wisconsin	5	7.05	2.95	2.63	71.87	4.05	11.45	1.83
Minnesota	5	7.29	2.63	2.81	72.87	4.01	10.39	1.66
Iowa	4	6.27	3.08	2.71	71.37	4.01	12.56	2.01
Nebraska	1	7.58	3.00	2.70	71.12	3.35	12.25	1.96
Dakota	5	5.81	2.99	2.77	71.75	3.66	13.02	2.08
Montana	3	6.37	2.62	2.56	75.17	3.48	9.80	1.57
South Carolina	1	6.85	2.65	2.45	73.62	4.10	10.33	1.65
Kentucky	1	6.00	2.90	2.37	75.73	4.25	8.75	1.40
Utah	1	7.70	3.40	2.53	72.99	2.88	10.50	1.68
Arizona	1	6.26	2.90	2.63	74.30	4.28	9.63	1.54
Washington	1	5.95	3.50	2.98	70.97	4.35	12.25	1.96
Oregon	2	6.23	2.92	2.38	74.23	3.91	10.33	1.65
California	3	5.80	3.30	2.74	74.86	4.25	9.05	1.45
Wyoming	1	6.70	2.20	2 52	74 03	3.00	11.55	1.85
Colorado	1	8.15	2.77	2 87	68.99	3.92	13.30	2.13

DISCUSSION OF THE DATA AND AVERAGES.

As Canadian barley forms the greater portion of our supply, it will be considered first, and that of the United States compared with it.

Maercker found that the finest grain contained not more than 8 per cent. of albuminoids and consisted of at least 80 per cent. of mealy kernels. These two factors, together with the brightness of the grain, he considered to be the characteristics by which its quality should be judged.

Of the twelve typical specimens of last year's Canadian crop none were below 9 per cent. of albuminoids, the average being 9.83, and only six contained 60 per cent. of kernels which were mealy or half mealy in structure. They cannot be said therefore to be equal to what are considered extremely fine barley in Germany. They do, however, reach and in most cases exceed the average production of foreign countries, and may be considered as of extremely good quality for samples from actual trade lots, and better than those produced the world over, as may be seen by comparison with the investigations which have been quoted on previous pages. In weight per bushel they are about the same as the average of Maercker, and in moisture, as with all our grain, much drier than the product of damper climates.

The differences in the different grades are marked almost entirely by brightness and perfection of the kernel, there being a remarkably clos

agreement in all other respects. This shows how important a factor climate and care in harvesting and handling are in enhancing or depreciating the value of the grain. The latter factor, care, is almost entirely within the control of the farmer, while varying seasons, of course, influence the former. Of the different districts that north of Lake Erie produces the specimens richest in nitrogen, which would therefore be graded lowest as far as this influences our judgment, thus agreeing with current opinion. In mealiness these specimens are much ahead of all the others, and this ought to more than balance the slightly higher percentage of albuminoids. The summer rains, however, by coloring the grain have the greatest influence in determining quality, and eventually make the barley of this district the least desirable. The remaining districts, north of Ontario, produce grain much alike, that from the B district averaging heavier in weight per bushel, and that from D being a little less nitrogenous. As a whole these Canadian barleys certainly form a very good standard of reference.

BARLEYS OF THE UNITED STATES.

In comparing the barleys of the United States with those of Canada, it appears at once that, as a whole, the former average about as mealy in consistency as the latter. Examined by distribution geographically, the Eastern grain is found to be much less mealy than the Western, that of the Northwest being the richest in mealy kernels. Again, however, we find that but two out of sixty-four samples contained 80 per cent. or over of mealy or half-mealy kernels. In weight per bushel there is no variation from Canadian and foreign grain, but in size the barleys of the United States, as a whole, are larger than those of Canada. Unfortunately we have no data for those of foreign production. The Eastern grain is no larger than the Canadian, and the average is increased by the large size of that from the Northwest and the Pacific Slope, which at the same time has an increased weight per bushel.

In brightness, the samples from those portions of the country having a dry climate at harvest time, especially the Pacific Slope and the Northwest, were far superior. This is an important feature in considering the best areas for the production of good malting barley; and while California as yet furnishes almost nothing for brewing purposes, it would seem to be one of our best fields. The high percentage of albuminoids stored up in the peculiar climate of the Northwest, while an advantage in the wheat grain, would be a serious objection in barley. In this respect it appears that the average amount of albuminoids in the barley of the United States is greater than that of Canada, and far ahead of anything which Maercker would consider desirable. California alone is 1 per cent. below the average for the rest of the country, there being

less than one-half per cent. difference from 11.50 per cent. in the average for all but California, which has 10.50 per cent. This is higher than was found in the Canadian grain, so that it may safely be said that the latter is at present the best in the market and superior to our own.

Among the analyses the following extremes are found:

	Highest.	State.	Lowest.	State.
	Per cent.		*Per cent.*	
Water	9.15	Minnesota	4.53	California.
Ash	4.43	California	1.50	Minnesota.
Oil	3.54	Indiana	2.06	Oregon.
Carbhydrates	76.79	Montana	68.99	Colorado.
Crude fiber	4.65	Ohio	2.64	Illinois.
Albuminoids	14.88	Dakota	8.75	Kentucky and Oregon.
Weight of 100 grains ..... drams	4.900	California	2.630	Pennsylvania.
Weight per bushel ..... pounds	60.2	Utah	50.4	Do.
Per ct. of mealy and half mealy kernels	100.00	Montana	16.0	Vermont.

Dakota sustains its reputation for high nitrogen and Oregon for low, but the variations in this constituent are not as wide as in wheat, barley, like rye, appearing to be less affected in this respect, although Maercker's experiments show that barley responds in its percentage of albuminoids readily to nitrogenous manuring. His seed was, however, very poor in albuminoids—7.7–8.0 per cent.—and would naturally increase when the conditions were made favorable.

In Koenig's collection of analyses of this grain he gives as the average of 127 specimens:

	Per cent.
Water	13.77
Ash	2.69
Oil	2.16
Carbbydrates	64.93
Crude fiber	5.31
Albuminoids	11.14
Total	100.00

This is but little different from the average production of the United States, and would point to the fact that our country, at any rate in certain portions, produces as good malting barley as others. Canada is a witness to this fact, as shown by the specimens which have been examined from there, which are well above foreign averages in starchiness. Experience and care have taught the Canadians, in connection with their favorable climate, the means of producing an excellent grain, superior to other parts of the country. It seems quite possible for the farmers in many portions of the United States, and especially California, the climatic conditions of which are such as to avoid damaging summer rains, with no too dry and hot a climate, to increase our supply of barley of good quality by attention to the conditions which

have been mentioned, and thus prevent the necessity of importing grain which should be produced at home.

There is one condition which in the case of wheat was found to be of evident effect. Although almost all the specimens examined were spring-sown grain, twelve of winter barley were found to contain but 10.05 per cent. of albuminoid, as compared to 11.42 in the spring varieties. Whether this could be made of any importance in practice cannot of course be decided except by the possibilities of the culture of winter barleys, which as yet seem to be small. Our dry and hot climate, ripening the grain before it has had time to fill out the kernel with starch, and the liability to discoloration from summer showers, are the two disadvantages we have to contend with.

In a few samples the hull or husk was detached from the grain and the amount determined.

Barley—percentage of grain and hulls.

Number.	Grain.	Hull.	Number.	Grain.	Hull.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
4015	83.06	16.94	4179	86.28	13.72
4081	83.78	16.22	4202	84.93	15.07
4090	83.70	16.30	4205	87.45	12.55
4097	84.25	15.75	4220	84.96	15.04
4107	85.72	14.28			
4156	84.01	15.99	Average	84.78	15.22
4166	84.47	15.53			

The extreme amounts are 16.94 and 12.55 per cent; not nearly as large as is the case with oats.

The composition of these specimens was as follows:

Composition of American barleys (hulled), arranged by States.

State.	Serial number.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
New York	4220	6.88	1.88	2.20	75.22	1.22	12.60	2.02
Do	4235	6.25	2.40	2.60	76.27	1.98	10.50	1.68
Michigan	4156	5.55	2.35	2.84	76.14	1.74	11.38	1.82
Indiana	4081	6.55	2.20	2.30	73.77	1.88	13.30	2.13
Minnesota	4166	5.60	2.20	2.55	76.91	1.19	11.55	1.85
Do	4179	6.00	2.10	2.76	76.35	1.41	11.38	1.82
Iowa	4090	6.41	2.15	3.12	74.67	2.27	11.38	1.82
Do	4097	6.35	1.98	2.65	75.52	1.25	12.25	1.96
Do	4107	6.25	2.15	2.76	75.19	1.40	12.25	1.96
Missouri	4188	7.50	2.02	2.81	73.95	1.47	12.25	1.96
Nevada	4202	7.20	2.38	2.77	75.93	1.92	9.80	1.57
Do	4205	2.87	1.99	2.47	81.31	1.73	9.63	1.54
California	4015	5.80	2.60	2.61	76.03	1.23	11.73	1.88
Do	4382	6.85	2.05	2.61	74.49	1.40	12.60	2.02
Colorado	3584	7.78	2.30	2.86	71.16	1.90	14.00	2.24

Average composition of American barleys (hulled), arranged by States.

State.	No. of analyses.	Water.	Ash.	Oil.	Carbhydrates.	Fiber.	Albuminoids.	Nitrogen.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
United States	15	6.26	2.18	2.66	75.53	1.60	11.77	1.88
Northern States	10	6.34	2.14	2.66	75.40	1.58	11.88	1.90
Western States	5	6.10	2.27	2.66	75.78	1.64	11.55	1.75
New York	2	6.57	2.14	2.40	75.74	1.60	11.55	1.85
Michigan	1	5.55	2.35	2.84	76.14	1.44	11.38	1.82
Indiana	1	6.55	2.20	2.30	73.77	1.88	13.30	2.13
Minnesota	2	5.80	2.15	2.66	76.63	1.30	11.46	1.83
Iowa	3	6.34	2.09	2.84	75.13	1.64	11.96	1.91
Missouri	1	7.50	2.02	2.81	73.95	1.47	12.25	1.96
Nevada	2	5.04	2.28	2.62	78.62	1.83	9.71	1.55
California	2	6.33	2.32	2.61	75.26	1.32	12.16	1.95
Colorado	1	7.78	2.30	2.86	71.16	1.90	14.00	2.24

The changes are merely such as one would expect from the removal of the fibrous hull. The percentages of albuminoids, fiber, and carbhydrates are increased, that of ash and water diminished. The results are merely of value to serve as a comparison of this cereal in its hull-less condition with the other cereals in a similar state.

Our investigations as a whole seem to prove that, while at present Canadian barleys are superior to those grown in the United States, the result is due more to a lack of understanding of the proper localities and methods of cultivation than in any obstacle in the way of extending the production to an extent to do away with our dependence on importation. Field experiments are now most desirable as a means of deciding upon the best varieties and methods as soon as a study of the climatic conditions shall enable us to select those portions of the country best suited to this cereal. In time, no doubt, California, whose climate in many parts is well adapted to the growth of barley for malting purposes, will make itself felt if, as appears probable, the quality of her barleys in the market answers to the expectations raised by laboratory examination.

ANALYSES OF OATS, BARLEY, AND RYE IN DETAIL.

In our first report several analyses of wheat were published in which the carbhydrates were separated into their proportions of sugars, starch, and gum, and the albuminoids into those soluble in alcohol of 80 per cent. strength and those insoluble. In the Annual Report of the Department for 1878 several analyses of corn were presented in the same way. For comparison with these results, which are of interest, several have been made of oats, barley, and rye:

Analyses of oats, barley, and rye in detail.

OATS.

Number.	Weight of 100 grains.	Moisture.	Ash.	Fat.	Sugar, &c.	Dextrine, &c.	Starch.	Albuminoids soluble in 80 per cent. alcohol.	Albuminoids insoluble in 80 per cent. alcohol.	Fiber.	Total nitrogen.	Total nitrogen × 6.25.
3044	2.090	6.32	2.25	7.86	5.59	3.68	58.87	.97	13.56	.90	2.32	14.53
3045	1.756	5.03	2.38	8.25	6.21	3.68	59.04	1.69	11.26	1.56	2.07	12.95
3049 (4)	1.798	6.57	2.02	8.64	5.84	3.12	58.34	1.50	12.68	1.29	2.27	14.18
3078	1.878	8.00	2.17	4.48	6.02	3.96	58.29	1.72	14.21	1.15	2.55	15.93
3098	1.684	7.38	2.61	7.60	5.96	.40	60.81	1.86	12.32	1.08	2.27	14.18
3127	1.892	6.08	3.07	7.83	5.67	2.82	60.18	2.15	11.15	1.05	2.13	13.30
3175	1.495	7.07	2.38	7.23	5.67	3.90	58.47	1.95	11.88	1.45	2.21	13.83
3187	1.922	7.21	1.95	8.15	5.66	3.56	58.24	1.36	12.64	1.23	2.24	14.00
3210	1.780	6.95	2.45	8.21	6.56	4.52	53.56	2.43	14.02	1.30	2.63	16.45
3235	2.139	7.28	1.78	8.52	5.80	3.86	58.08	2.20	11.28	1.20	2.16	13.48
3243	1.703	6.34	2.03	6.98	6.28	3.82	54.92	1.42	16.62	1.60	2.88	18.04
3260	1.648	6.90	2.43	7.75	6.39	3.78	56.17	2.71	12.55	1.23	2.44	15.26
3262	1.606	6.78	2.07	7.40	6.10	3.42	53.69	2.78	16.66	1.10	3.11	19.44
3270	1.656	6.77	2.20	8.88	6.52	3.60	56.25	(?)	14.53	1.25	2.32	14.53
3323	1.506	7.00	2.06	8.12	5.43	3.42	54.31	1.15	17.05	1.46	2.91	18.20
3335	1.595	6.13	2.35	8.58	6.43	3.48	56.64	2.31	12.57	1.51	2.38	14.88
3391	1.313	8.75	2.15	9.47	6.50	3.86	56.08	2.70	9.20	1.29	1.90	11.90
3411	1.355	6.95	1.60	7.77	6.69	3.58	52.59	1.83	17.42	1.57	3.08	19.25

BARLEY.

4067	2.920	6.52	3.08	2.66	7.71	3.60	60.46	4.25	8.35	3.37	2.02	12.60
4098	3.010	5.69	3.18	2.75	5.82	3.48	62.98	3.18	8.55	4.37	1.88	11.73
4151	3.450	6.44	2.97	2.70	7.12	3.92	60.29	3.76	9.37	3.43	2.10	13.13
4153	2.280	6.37	2.59	2.73	8.73	4.64	56.36	4.79	9.91	3.88	2.35	14.70
4163	2.610	7.60	1.50	2.69	5.97	3.58	64.24	2.85	8.00	3.57	1.74	10.85
4198	2.830	7.58	3.00	2.80	8.30	62.72		4.38	7.87	3.35	1.96	12.25
4233	3.380	6.95	2.64	2.66	6.01	3.14	65.32	3.07	7.08	3.13	1.62	10.15
4243	3.410	7.39	2.45	2.48	6.93	3.80	62.37	3.41	7.44	3.73	1.74	10.85
4269	3.170	6.25	3.07	2.40	6.21	3.40	63.52	3.01	7.49	4.65	1.68	10.50
4277	5.110	6.20	2.78	2.71	5.38	3.46	66.72	2.86	5.89	4.00	1.40	8.75
4324	3.480	6.50	2.40	2.65	7.79	3.00	61.58	4.23	8.37	3.48	2.02	12.60
4326	2.980	6.55	2.90	2.75	7.60	3.40	60.57	4.02	8.06	4 15	1.93	12.08
4374	4.550	4.53	4.43	2.72	7.44	3.42	63.88	3.42	5.68	4.48	1.46	9.10
4390	2.710	6.00	3.20	2.74	7.21	3.70	61.32	3.95	8.13	3.75	1.93	12.08

RYE.

5029	2.516	9.69	1.88	1.80	8.10	4.76	62.52	2.20	7.60	1.45	1.57	9.80
5052	1.240	8.24	1.91	2.17	7.93	4.50	60.47	3.17	9.78	1.83	2.07	12.95
5075	1.840	8.45	2.36	1.98	8.49	4.38	59.61	3.45	9.68	1.60	2.10	13.13
5079	1.670	9.18	1.62	1.79	6.25	4.56	64.34	2.17	9.03	1 15	1.79	11.20
5107	2.034	8.32	2.08	1.93	6 92	4.54	63.55	2.14	9.24	1.28	1.82	11.38
5116	2.250	8.85	2.06	1.93	7.81	5.54	60.35	3.11	8.97	1.38	1.93	12.08
5140	2.164	9.70	2.10	1.94	7.29	5.32	60.55	2.44	9.26	1.38	1.88	11.73
5215	2.670	8.93	2.03	1.74	6.20	6.02	62.12	1.76	9.97	1.23	1.88	11.73
5231	2.310	8.98	2.16	1.69	7.85	5.19	61.33	2.17	9.38	1.25	1.85	11.55
5248	1.873	8.75	2.01	1.85	7.52	4.20	62.74	2.18	9.20	1.55	1.82	11.38
5269	2.080	8.15	1.70	1.93	7.89	4.14	62.23	2.71	9.37	1.88	1.93	12.08
5282	2.422	9.35	2.15	1.86	9.46	4.44	59.81	3.08	8.65	1.20	1.88	11.73
5290	2.154	9.75	2.10	1.70	6.74	4.36	63.31	1.90	8.25	1.89	1.62	10.15
5348	2.064	8.35	2.68	1.75	7.89	4.44	58.73	3.03	9.05	1.54	1.93	12.08
5351	2.012	8.65	2.32	1.86	7.10	5.00	62.40	2 76	8.44	1.77	1.79	11.20
5357	1.087	8.80	1.96	1.84	7.45	4.46	62.59	2.56	8.99	1.35	1.85	11.55
5360	1.846	8.38	1.90	1.38	7.83	4.80	62.19	2.15	9.39	1.56	1.90	11.90

The sources of the specimens will be found under their respective serial numbers in the general descriptive tables. They are from various parts of the country, and represent fairly the average production and variations.

For comparison, averages of the above results have been drawn, as well as of those of wheat and corn previously published, excluding the Colorado wheats.

Averages of detailed analyses of cereals.

	Wheat.	Corn.	Oats.	Barley.	Rye.
No. of analyses	27	21	18	14	17
Water	9.25	9.34	6.92	6.47	8.85
Ash	1.84	1.54	2.22	2.87	2.06
Oil	2.30	5.54	7.87	2.67	1.83
Sugar, &c	3.50	2.18	6.07	7.02	7.57
Dextrine and sal starch	2.30	2.18	3.47	3.55	4.75
Starch	67.88	66.91	56.91	62.09	61.87
Albuminoids soluble in 80 per cent. alcohol	3.58	5.84	1.82	3.66	2.53
Albuminoids insoluble in 80 per cent. alcohol	7.45	4.96	13.43	7.86	9.07
Fiber	1.90	1.41	1.29	3.81	1.47
	100.00	100.00	100.00	100.00	100.00
Total albuminoids	11.03	10.80	14.25	11.52	11.60

From the figures it is seen that oats and barley are much drier than the remaining cereals. This is due in the case of both to the outer chaffy covering, which readily gives up its water. In the oats, however, this had been removed, but its effect in abstracting moisture has evidently remained. The smaller size of the rye kernel, no doubt, accounts for its somewhat lower moisture than wheat and corn, and this, too, has perhaps an effect upon oats.

Of all the grains barley is the richest in ash—this, too, probably due to its hull—followed by oats, the richest actually in ash in kernel.

In oil, oats is ahead of corn by over 2 per cent., and far ahead of all the other cereals.

In sugar, barley and rye are superior, with oats comparatively rich, and corn the poorest.

In dextrine or gum, rye is the richest, having twice as much as wheat and corn, and 1 per cent. more than oats and barley.

The accumulation of its many other constituents makes oats by far the least starchy of the cereals, followed by rye and barley, with wheat as the most starchy. This latter fact, from a flouring point of view, is important, taken in connection with the character of the nitrogen of wheat and its small amount of oil. Of the determinations of the nitrogenous constituents it must be said that the solubility does not show much in regard to their quality. Part of the gluten of wheat goes into the alcohol extract and part remains insoluble, the latter being chiefly the gluten-casein. In corn the soluble portion is known often as zein and is more distinctive than the soluble albuminoids of the other cereals.

It is the largest in amount of the soluble nitrogenous constituents found in any of the grains, exceeding the insoluble portion. Oats, on the other hand, contains the least soluble albumen.

Barley is, in the condition in which it was analyzed, most fibrous, but in its hulless state no more so than wheat. Aside from this the most fiber is found in wheat and the least in oats. From the averages wide variations will be found among individual analyses, which are due to circumstances of environment which our data do not at present permit a study of. A large increase of analyses and conditions which may in time accumulate will render this possible.

MILLING PRODUCTS.

In our second report an examination of the products of roller milling was presented, with especial reference to the process as applied to the hard spring wheats of the Northwest. This examination has since been extended to the winter wheats of Kansas, as represented by the products of a small roller mill at Ottawa. The data are as follows:

Mill products from Ottawa, Kans.

Description of sample.	Serial number.	Water.	Ash.	Oil.	Carbohydrates.	Fiber.	Albumen.	Nitrogen.	Moist gluten.
		Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.
Whole wheat	6014	9.55	1.78	1.27	72.97	1.88	12.25	1.96	30.72
First break	6015	8.68	1.90	2.22	72.67	1.93	12.60	2.02	31.74
Second break	6016	9.15	1.85	2.17	71.57	2.48	12.78	2.04	27.18
Third break	6017	9.30	2.13	2.16	71.19	2.26	12.96	2.07	27.63
Fourth break	6018	8.18	2.55	2.62	70.63	2.77	13.65	2.18	24.90
Fifth break	6019	9.40	4.15	3.41	63.81	4.00	15.23	2.44	.....
Sixth break	6020	7.60	5.20	3.99	62.56	5.60	15.05	2.41	.....
Bran	6021	8.45	6.30	4.64	58.28	6.60	15.75	2.52	.....
Ship-stuff or shorts	6022	8.18	3.38	5.65	62.45	2.84	17.50	2.80	.....
Chop	6023	11.40	.78	2.00	73.56	1.23	11.03	1.76	26.14
Fine middlings	6024	11.43	.38	1.11	75.28	.42	11.38	1.82	29.10
Medium middlings	6025	11.03	.50	1.29	74.93	1.40	10.85	1.74	28.76
Coarse middlings	6026	8.88	.83	1.84	77.25	.70	10.50	1.68	{29.09 29.13
Germ middlings	6027	10.75	2.30	3.99	67.09	1.69	14.18	2.27	.....
Tailings from fine middlings purified	6028	9.60	3.10	5.07	63.22	1.86	17.15	3.74	.....
Finished germ	6029	8.70	5.20	7.47	54.91	3.59	20.13	3.22	.....
Reduction of tailings from third middlings	6030	11.35	.43	1.23	75 39	.40	11.20	1.79	28.45
Fine middling flour	6031	11.25	.33	6.05	71.06	.46	10.85	1.74	25 02
Second grade flour	6032	11.30	.38	1.15	75.91	.40	10.85	1.74	27.75
Flour from coarse middlings	6033	10.85	.30	.93	78.60	.12	9.20	1.48	23.79
Flour from first break	6034	11.50	.68	.96	78.13	.85	7.88	1.26	19.28
Break flour from second, third, fourth, and fifth break	6035	11.42	.43	1.06	76.89	.22	9.98	1.60	27.53
Straight-grade flour	6036	11.90	.35	1.01	76.34	.25	10.15	1.52	25.65
Patent flour	6037	11.02	.35	1.01	77.80	.19	9.63	1.54	22.07
Low-grade flour	6038	10.60	.85	2.09	72.29	.52	13.65	2.18	41.67
Flour from third middlings	6039	12.48	.32	1.17	73.75	.20	12.08	1.93	33.83

The winter wheat from which the Kansas products were obtained is a larger and softer grain than the spring varieties of Minnesota. It is much less oily than the usual production of the country at large, and while above the average in nitrogenous constituents and representing about the usual percentage found in that portion of the country where it was grown, it is of course lower in albuminoids than the Minnesota grain. The relative results in the breaks are, however, about the same

in both cases. There is a somewhat greater accumulation of ash and fiber in the last breaks, and the shorts are proportionately richer in nitrogen. This is hardly what would be expected in milling softer wheats, but shows that the process is as effective as with spring varieties in separating the endosperm or floury portion of the grain from the outer coats. The increase in the ash and fiber may be due, however, to a larger proportion of germ in the branny products than is the case in Minnesota.

The grading and purification of the middlings in the two mills is so different that it is difficult to make a comparison of their relative purity. The finest middlings are in both cases the most impure, carrying the most bran and germ, and consequently being rich in nitrogen. The tailings from the purification of these middlings are largely germ and bran, and are very rich in ash, oil, and albuminoids. The flour from the fine middlings is richer in both cases in nitrogen, owing to its contamination with germ and bran, and the best is produced from the coarse. There is a somewhat less relative proportion of the total albuminoids of the wheat in the coarse middlings flour of winter than of spring wheat, a condition which is also observed in the finished products, patent and straight grades. The low grade of the Kansas mill will be seen to be quite different from that so called in Minnesota. It is, it seems, more nearly what is there known as a baker's grade. The low grade from spring wheat, while rich in nitrogen from the amount of bran and germ it contains, is very poor in gluten. The baker's grade from that grain is not only rich in nitrogen but also in gluten; with this the low-grade Kansas flour corresponds, due probably to the fact that in the smaller mill the process of refinement is not carried to such extremes. In the finished germ there is also visible a vast difference. It is not separated in as clean and entire condition from the winter wheat, either owing to lack of facilities or difficulties in the way, and is consequently less rich in nitrogen. The break flours present, too, as great a contrast as the low grade, that from Kansas being much more starchy and less glutinous or stiff. It is of better quality, for, although poor in gluten, it does not containing as much germ.

Depending largely on the original wheat, the finished products in Kansas are not as stiff as those from spring grain, but this was to be expected, and the greatest differences which have been observed are due fully as much, as far as we can judge, to method of manufacture as to physical differences in the grain. That there are some to be ascribed to this cause is evident from the lower relation of the purer products in Kansas to the original grain. This was observed also in roller flours from Ohio and Washington, D. C., in our former investigations.

There seems to be every advantage over ordinary milling with stones in the use of this process with our winter wheats, both in economy and quality, although, perhaps, not as great as with the hard Northwestern

grain, nor as large in small as in large mills. The rapid extension of the system shows that practice has demonstrated what chemical and physical investigations have shown to be advisable, and it seems from a comparison of our analyses of the two series that the more the products are differentiated the more satisfactory are the results.

In another place an investigation of the proximate composition of the germ will soon be published, showing the presence of remarkably large amounts of cane sugar, together with another sugar not yet identified, and proving not to be raffinose; and of allantoin, a nitrogenous substance hitherto found only once as a plant constituent and whose presence is of great importance from a botanico-physiological point of view.

MISCELLANEOUS ANALYSES OF CEREALS.

In the routine work of the division many miscellaneous samples of cereals have been from time to time examined. The results are here collected. The sources from which they have been derived are as follows:

Sources of specimens.

WHEAT.

2763. From New Zealand. Selected sample. Crop of 1884.

2764. From Mr. McLaughlin, New Jerusalem, Ventura County, California. Crop of 1884.

2765. From Charles Woodhull, Wahpeton, Dak. Crop of 1884.

CORN.

1978. Bessarabian. From S. M. Clark, Washington, D. C. Crop of 1884.

2438. From T. J. Higgins, Morris County, Kansas. A fine large-eared Yellow Dent.

2428. From S. M. Clark, Washington, D. C. Crop raised from seed 2438. This sample the less perfect and most shriveled kernels of one cob. Crop of 1884.

2429. From S. M. Clark, Washington, D. C. The perfect and plump kernels of the above-mentioned cob.

2430. From Lake County, Tennessee. 1883. White Dent.

2431. From Giles County, Tennessee. 1883. White Dent.

2432. From Bradley County, Tennessee. 1883. White Dent.

2433. From Clay County, Kentucky. 1883. White Dent.

2434. From Brown County, Minnesota. 1883. White Dent.

2435. From Herkimer County, New York. 1883. Yellow Flint.

2436. From Jackson County, Minnesota. 1883. Red Dent.

2437. From Watonwan County, Minnesota. 1883. Yellow Dent.

2440. From ———, Florida. 1884. Yellow Dent.

OATS.

1973–5. From the collection of the Atchison, Topeka and Santa Fé Railroad. Grown in Kansas.

1976. From J. P. Hooke, Marysville, Tenn. Winter variety.

1977. From R. B. Potter, M. D., Dade County, Florida.

2766. Distributed by the Department. 1885. Welcome Oats.

2766. Distributed by the Department. 1885. Clydedale Oats.

3000. From New Zealand. 40 pounds per bushel. Crop of 1884.

RYE.

1971–2. From the collection of the Atchison, Topeka and Santa Fé Railroad. Grown in Kansas.

BARLEY.

1978. Distributed by the Department. 1884. Imperial.

The analyses are as follows:

Miscellaneous analyses, 1884–'85.

Cereals.	Serial number.	Locality.	Weight of 100 grains.	Water.	Ash.	Oil.	Carbohydrates.	Crude fiber.	Albuminoids.	Nitrogen.
Wheat	2763	New Zealand	5.036	9.40	1.25	1.76	71.49	1.75	14.35	2.30
	2764	California		7.00	2.45	4.95	71.32	2.90	11.38	1.82
	2765	Dakota		8.55	1.85	3.01	71.51	1.95	13.13	2.10
Corn (maize) kernel	1978	Dist. of Columbia		8.70	1.75	4.44	72.67	1.24	11.20	1.79
	2428	Dist. of Columbia		10.75	1.45	3.48	75.52	1.80	7.00	1.12
	2429	Dist. of Columbia		10.12	1.35	4.32	75.51	1.70	7.00	1.12
	2438	Kansas		10.00	1.50	4.37	71.38	1.90	10.85	1.74
	2430	Tennessee		11.15	2.05	4.34	72.18	1.70	8.58	1.37
	2431	Tennessee		9.65	2.05	4.95	71.32	2.40	9.63	1.54
	2432	Tennessee		10.45	1.65	4.57	71.73	2.15	9.45	1.51
	2433	Kentucky		10.55	1.70	4.17	73.10	1.90	8.58	1.37
	2434	Minnesota		9.60	1.75	4.53	72.55	2.12	9.45	1.51
	2435	New York		8.50	1.45	4.51	71.62	2.02	11.90	1.90
	2436	Minnesota		9.80	2.00	4.01	71.76	2.10	10.33	1.65
	2437	Minnesota		10.50	1.65	4.05	71.40	2.07	10.33	1.65
	2440	Florida		8.47	1.37	4.82	72.99	2.02	10.33	1.65
Oats	1973	Kansas		8.76	2.55	7.15	65.96		15.58	2.49
	1974	Kansas		8.87	2.60	5.79	68.39		14.35	2.32
	1975	Kansas		8.37	2.75	8.14	64.11		16.63	2.66
	1976	Tennessee		9.03	2.09	9.42	63.71		15.75	2.52
	1977	Florida		9.07	2.45	9.43	65.22		13.83	2.21
	2766	Imported		9.60	2.40	8.83	64.82		14.35	2.30
	2767	Imported				9.02				
	3000	New Zealand		*10.18	*2.32	*8.91	*65.34	*1.70	*11.55	*1.85
	3000	New Zealand		†7.60	†5.50	†.80	63.44	†20.56	*2.10	†.34
Rye	1971	Kansas		11.60	1.60	2.22	70.49	1.49	12.60	2.02
	1972	Kansas		11.20	1.80	1.88	71.32	1.40	12.40	1.99
Barley	1984	?		8.46	2.45	2.71	73.01	1.82	11.55	1.85

* Kernel 70.6 per cent. † Hulls 29.45 per cent.

It is unnecessary to call particular attention to these analyses. The New Zealand wheat was a selected exhibition sample, very large and heavy, and of rather a soft character. It is rather poor in ash and oil, and quite rich in albuminoids.

The specimens from California and Dakota sustain the usual reputation of the grain from those States.

The samples of corn vary very little in composition for the different localities. The only exception which it is of interest to observe is in the case of the plump and shriveled grains grown in the District of Columbia from seed produced in Kansas. While not varying at all among themselves in composition, the plump and shriveled grains have departed quite remarkably from the composition of the parent seed from Kansas. Among the remaining specimens the usual narrow limits of variation in this cereal are seen. Even Minnesota, which produces a wheat rich in nitrogen, does not excel in its corn in this respect.

The analyses of oats show no peculiarities; the sample from New

Zealand alone is rather low in albuminoids and not corresponding to the wheat with which it was associated. The kernels were analyzed free from hulls.

ANALYSIS OF WHEATS OF THE CROP OF 1885.

Recently several Minnesota wheats, harvested during the season of 1885, have been examined. They sustain the averages of previous years, or are slightly richer in albuminoids. The results follows together with those of seed wheats distributed by the Department in the autumn of 1885, the products of which it is hoped may be compared another year.

Analysis of wheats from Minnesota, 1885.

Variety.	Serial No.	Weight of 100 grains.	Water.	Ash.	Oil.	Carbhydrates.	Crude fiber.	Albuminoids.	Nitrogen.	Moist gluten.
		Grains.	*Per c.*	*Per c.*	*Per c.*	*Per c.*	*Per c.*	*Per c.*	*Per c.*	*Per c.*
Rice	6000	4.114	9.40	2.08	2.79	70.33	1.92	13.48	2.16	29.37
Blue Stem	6001	3.096	9.13	2.03	2.94	69.48	2.42	14.00	2.14	29.41
Scotch Fife	6002	2.649	9 18	2.43	2.65	70.47	1.79	13.48	2.16	32.31
Scotch Fife	6003	2.190	9.38	1.70	2.98	69.06	1.83	15.05	2.41	32.67
Scotch Fife	6004	2.565	8.93	2.03	2.89	68.75	2.00	15.40	2.46	38.45

Analysis of winter wheats distributed by the Department, November, 1885.

Variety.	Serial No.	Weight of 100 grains.	Weight per bushel.	Water.	Ash.	Oil.	Carbhydrates.	Crude fiber.	Albuminoids.	Nitrogen.	Moist gluten.
		Grains.	*Lbs.*	*Per c.*	*Per c.*	*Per c.*	*Per c.*	*Per c.*	*Per c.*	*Per c.*	*Per c.*
Four-Rowed Sheriff	6005	3.734	65.8	10.28	1.95	2.29	73.52	1.81	10.15	1.62	26.54
Red Mediterranean	6006	4.635	67.2	11.05	1.63	2.22	71.25	1.60	12.25	1.96	31.66
Diehl-Mediterranean	6007	4.222	65.8	10.45	1 65	2.25	72.97	2.00	10.68	1.72	32.22
Indian Winter	6008	3.126	65.5	10.29	2.23	2.06	72.24	1.72	11.55	1.85	19.16
White Crimean	6009	6.086	66.5	10.73	2.00	2.55	70.63	1.66	12.43	1.99	00.00
McGehee White	6010	2.990	66.4	10.48	1.88	2.22	71.34	1.83	12.25	1.96	33.61
Extra Early Oakley	6011	3.945	66.3	11.45	1.20	2.29	69.79	1.79	13.48	2.16	32.05
Genoese	6012	4.113	68.7	9.68	1.73	2.04	74.68	1.89	9.98	1.60	22.61
Egyptian	6013	5.308	68.6	9.83	1.78	2.04	74.52	1.50	10.33	1.65	29.43
	6040	(?)	(?)	9.88	1.90	2.40	72.11	1.46	12.25	1.96	32.04

CONCLUSION.

The results which have been collected and discussed in this and previous reports have shown the wide extent of the variations which occur in the physical and chemical properties of our cereal grains. They have extended over but a few years, and with conditions which have not been sufficiently varied or sufficiently under control. They have served to show, however, how many of the modifying causes are in the hands of the farmer or of the experimental stations, and, to a certain extent, the directions in which advance should be made. The co-operation of practical field-work is now necessary, with laboratory examinations of the results. Until this can be accomplished systematically further progress will be slow and uncertain.